User Manual

Allen-Bradley

ControlLogix Eight-channel Isolated Analog I/O Modules

Catalog Numbers 1756-IF8I, 1756-IRT8I, 1756-OF8I

Allen-Bradley • Rockwell Software

Rockwell Automation

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

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	WARNING: Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

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	BURN HAZARD: Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
	ARC FLASH HAZARD: Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

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This manual describes how to install, configure, and troubleshoot your ControlLogix® isolated analog I/O module.

You must be able to program and operate a ControlLogix controller to efficiently use your isolated analog I/O modules. If you need additional information, refer to Additional Resources on page 8.

ControlLogix isolated analog I/O modules convert analog signals to digital values for inputs and convert digital values to analog signals for outputs. Controllers use these signals for control purposes.

By using the producer/consumer network model, ControlLogix isolated analog I/O modules produce information when needed while providing additional system functions.

Studio 5000 Environment

The Studio 5000® Engineering and Design Environment combines engineering and design elements into a common environment. The first element in the Studio 5000 environment is the Logix Designer application. The Logix Designer application is the rebranding of RSLogix™ 5000 software and continue to be the product to program Logix5000™ controllers for discrete, process, batch, motion, safety, and drive-based solutions.

The Studio 5000 environment is the foundation for the future of Rockwell Automation® engineering design tools and capabilities. It is the one place for design engineers to develop all the elements of their control system.

IMPORTANT In addition to the Studio 5000 Logix Designer™ application, version 21 or later, you can use your ControlLogix isolated analog I/O modules in RSLogix 5000 software, versions 18…20, projects.

You must install Add-on Profiles (AOP) to use the modules in any Logix Designer application or RSLogix 5000 software project.

This publication describes configuration with Logix Designer application.

Some of the tasks that are described in this publication by using the Logix Designer application have slightly different screens when completed by using RSLogix 5000 software. The procedure order required to complete the tasks is primarily the same regardless of the programming application used to do so.

Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Documentation
1756 ControlLogix I/O Specifications, publication 1756-TD002	Provides specifications for ControlLogix analog and digital I/O modules as well as the accessories that can be used with each.
ControlLogix Digital I/O Modules User Manual, publication 1756-UM058	Provides information on how to install, configure, and troubleshoot ControlLogix digital I/O modules.
1756 ControlLogix Chassis and Power Supplies Installation Instructions, publication 1756-IN005	Provides information on how to install a wide range of ControlLogix chassis, power supplies, and chassis adapter modules.
Integrated Architecture and CIP Sync Configuration Application Technique, publication IA-AT003	Describes how to configure CIP Sync with Integrated Architecture™ products and applications.
ControlLogix System User Manual, publication 1756 UM001	Describes how to install, configure, program, and operate a ControlLogix system.
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation industrial system.
Product Certifications website, http://www.ab.com	Provides declarations of conformity, certificates, and other certification details.

You can view or download Rockwell Automation publications at http:/www.rockwellautomation.com/literature/.

To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Isolated Analog I/O Module Operation in the ControlLogix System

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ControlLogix controllers use isolated analog I/O modules to control devices in a ControlLogix control system. The modules are installed in a ControlLogix chassis and use a removable terminal block (RTB) or a Bulletin 1492 interface module(1) cable to connect to field-side wiring.

The modules use the producer/consumer network communication model. This communication is an intelligent data exchange between modules and other system devices in which each module produces data without first being polled.

Before You Begin

Before you install and use your module, complete the following tasks:

- Install and ground a 1756 ControlLogix chassis and power supply(2). You can use a standard power supply or a redundant power supply.

  For more information on installing 1756 ControlLogix chassis and power supplies, see Additional Resources on page 8.

(1) The ControlLogix system has been agency certified using only the ControlLogix RTBs (catalog numbers 1756-TBCH, 1756-TBNH, 1756-TBSH and 1756-TBS6H). Any application that requires agency certification of the ControlLogix system using other wiring termination methods can require application specific approval by the certifying agency.

(2) In addition to standard ControlLogix power supplies, ControlLogix Redundant Power Supplies are also available for your application. For more information on these supplies, see the ControlLogix Selection Guide, publication 1756-SG001, or contact your local distributor or Rockwell Automation representative.

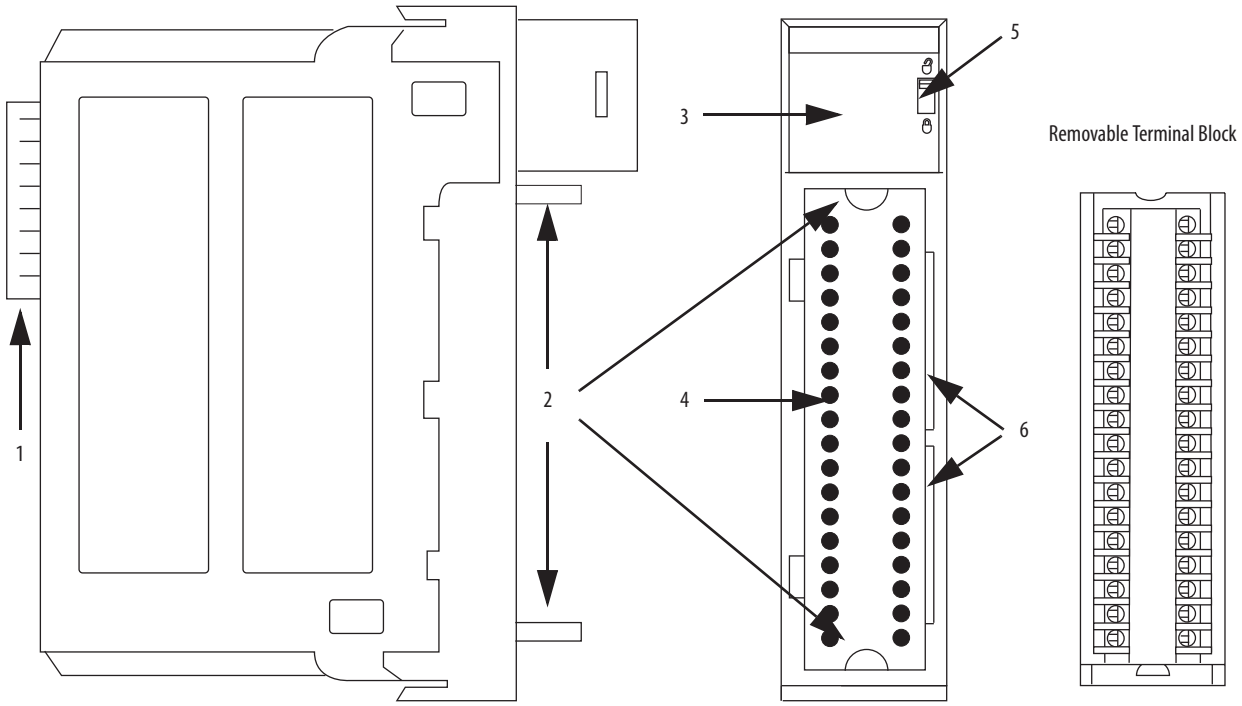
- Verify that you have an RTB or IFM and its components.

IMPORTANT RTBs and IFMs are not included with your module purchase.

Table 1 - Types of ControlLogix Isolated Analog I/O Modules

Cat. No.	Description	RTB Used	Page
1756-IF8I	8-point general purpose isolated analog current/voltage input module	36-pin (1756-TBCH or 1756-TBS6H)	45
1756-IRT8I	8-point isolated combined temperature and mV sensing input module		65
1756-OF8I	8-point general purpose isolated analog current/voltage output module		93

Figure 1 - Parts Illustration of the ControlLogix Isolated Analog I/O Module



Item	Description
1	**Backplane connector** - Interface for the ControlLogix system that connects the module to the backplane.
2	**Top and bottom guides** - Guides provide assistance in seating the RTB or IFM cable onto the module.
3	**Status indicators** - Indicators display the status of communication, module health, and input/output devices. Indicators help in troubleshooting anomalies.
4	**Connectors pins** - Input/output, power, and grounding connections are made to the module through these pins with the use of an RTB or IFM.
5	**Locking tab** - The locking tab anchors the RTB or IFM cable on the module, maintaining wiring connections.
6	**Slots for keying** - Mechanically keys the RTB to prevent inadvertently making the wrong wire connections to your module.

Ownership

Every I/O module in the ControlLogix system must be owned by a ControlLogix controller. This controller performs the following:

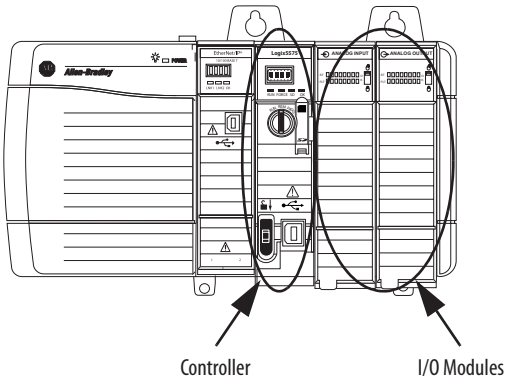
- Stores configuration data for every module that it owns.
- Resides in the local or remote chassis in regard to the I/O module's position.
- Sends the I/O module configuration data to define the module's behavior and begin operation in the control system.

Each ControlLogix I/O module must continuously maintain communication with its owner to operate normally. Typically, each module in the system has only one owner. Input modules can have more than one owner. Output modules, however, are limited to a single owner.

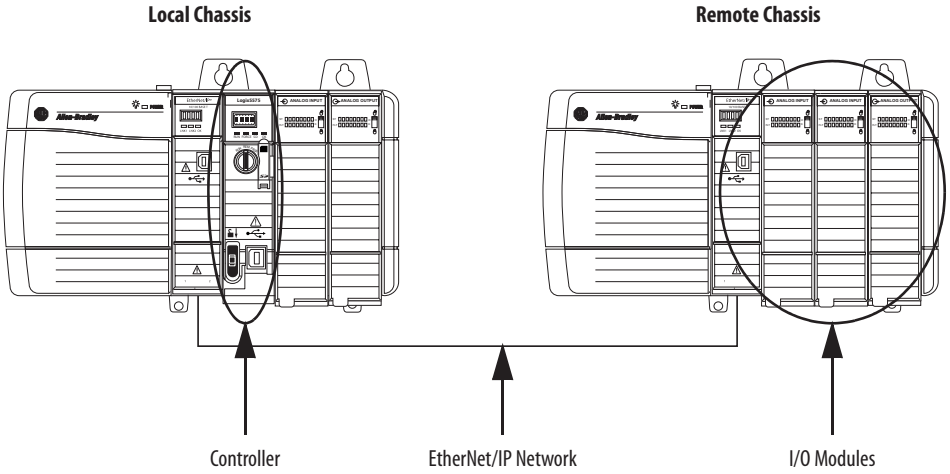
Configure a Module

You use the I/O configuration portion of the Logix Designer application to configure each I/O module. An I/O module can reside in either of the following:

- **Local chassis** - The chassis in which the owner-controller resides.



- **Remote chassis** - A chassis that does not contain the module's owner-controller but is connected to the local chassis over the EtherNet/IP network or ControlNet network.



The Logix Designer application transfers configuration data to the controller during the program download. Subsequently, data is transferred to the I/O modules in the local and remote chassis.

The I/O module can operate immediately after the project download from the owner-controller is complete.

Direct Connections

A direct connection is a real-time data transfer link between the controller and the device that occupies the slot that the configuration references.

IMPORTANT ControlLogix isolated analog I/O modules support only direct connections

When you download module configuration to a controller, the controller attempts to establish a direct connection to each module referenced by the configuration.

If controller configuration refers to a chassis slot in the system, the controller periodically checks for the presence of a device there. If a device is detected, the controller sends the configuration, and one of the following occurs:

- If the configuration is appropriate to the module detected, a connection is made and operation begins.
- If the configuration is not appropriate to the module detected, the data is rejected and the Logix Designer application indicates that an error occurred.

  The configuration can be inappropriate for any of a number of reasons. For example, a module's configuration can include a mismatch in electronic keying that prevents normal operation.

The controller maintains and monitors its connection with a module. Any break in the connection, for example, the removal of the module from the chassis while under power, causes a fault.

The Logix Designer application indicates that the fault occurred in the fault status bits associated with the module. The Logix Designer application monitors the fault status bits to annunciate the module's failures.

Input Module Operation

In traditional I/O systems, controllers periodically poll input modules to obtain their input status.

In the ControlLogix system, the controller does not poll the isolated analog input modules. Instead, the modules broadcast their input data, that is, channel and status data, to their backplane periodically.

Requested Packet Interval (RPI)

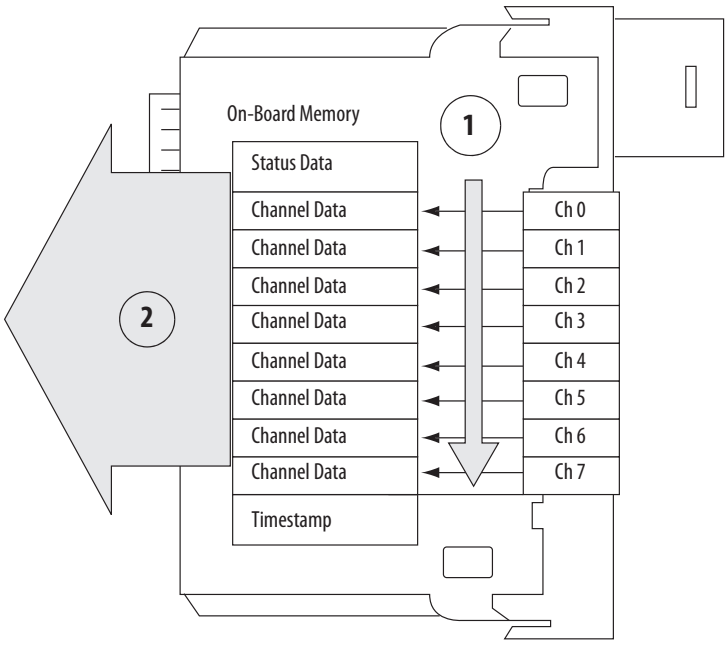
The RPI is a configurable parameter that defines a specific period of time at which the module broadcasts input data to the backplane. Valid RPI values are 1...750 ms. The default value is 100 ms.

You set the RPI value at initial module configuration and adjust it as necessary only when the controller is in Program mode.

IMPORTANT	Other ControlLogix analog input modules offer the **Real Time Sample (RTS)** parameter that determines when channel data is scanned and stored on the module's on-board memory until broadcast to the chassis backplane. The 1756-IF8I and 1756-IRT8I modules **do not offer the RTS parameter**. With these modules, the channel sampling rate is exclusively determined by the RPI value.

At the RPI, the following events occur.

1. The module scans its channels for input data.
2. The module broadcasts the data to its backplane.



The input module broadcasts data to the chassis backplane immediately after the scan:

- When the module resides in the local chassis, the controller receives the data immediately.
- When the module resides in a remote chassis, the time elapsed before the controller receives it depends on the configuration of the network connecting the local and remote chassis.

  For more information, see Input Modules in a Remote Chassis.

Input Modules in a Local Chassis

When an input module resides in a local chassis, as shown on page 11, after the input module broadcasts data to the chassis backplane, the controller receives it immediately.

Input Modules in a Remote Chassis

When an input module resides in a remote chassis, as shown on page 12, it is considered remote input module.

At the RPI, the following events occur.

1. The remote input module scans its channels for input data.
2. The remote input module broadcasts the data to its backplane.
3. The network communication module in the chassis with the I/O module sends the data over the network to the controller.

Broadcast Method

The isolated analog input module broadcasts data by using one of the following connection methods:

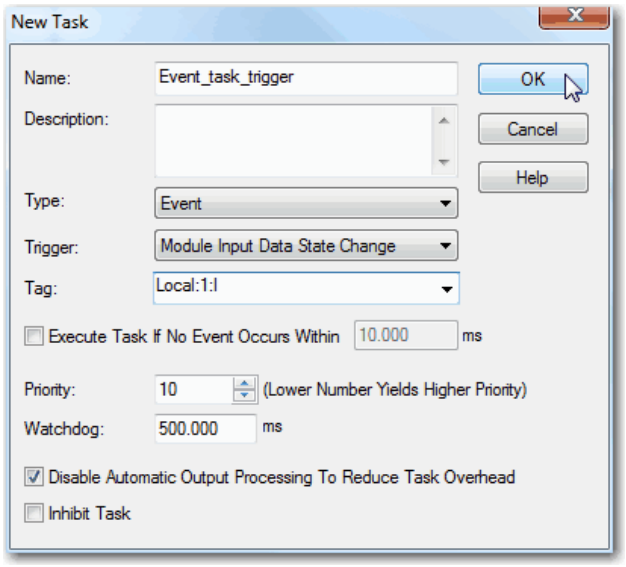
- Multicast - Data is sent to all network devices
- Unicast - Data is sent to a specific controller depending on the module's configuration

For more information on guidelines for specifying RPI rates, see the Logix5000 Controllers Design Considerations Reference Manual, publication 1756-RM094.

Triggering Event Tasks

ControlLogix isolated analog input modules can trigger an Event task. The Event task causes the controller to execute a section of logic immediately when a triggering event occurs. You can configure the Event task to be triggered if new input data is sent at the RPI.

The following graphic shows an Event task dialog box in Logix Designer application.



Event tasks are useful for synchronizing process variable (PV) samples and proportional integral derivative (PID) calculations.

For more information on Event tasks, see the Logix5000 Controllers Tasks, Programs, and Routines Programming Manual, publication 1756-PM005.

Output Module Operation

The RPI defines when a controller sends data to the isolated analog output module and when the output module echoes data. The controller sends data to an output module only at the RPI.

When an output module receives new data from the controller, the module multicasts or 'echoes' a data value that corresponds to the signal present at its terminals to the rest of the control system. This feature, called Data Echo, occurs whether the output module resides in the local or remote chassis.

Depending on the value of the RPI, with respect to the length of the controller program scan, the output module can receive and 'echo' data multiple times during one program scan.

When the RPI is less than the program scan length, the module's output channels can change values multiple times during a single program scan. The controller does not depend on reaching the end of the program to send data.

Output Modules in a Local Chassis

When an output module resides in a local chassis, as shown on page 11, it receives data almost immediately after the owner-controller sends it.

Output Modules in a Remote Chassis

When an output module resides in a remote chassis, as shown on page 12, and is connected to the local chassis via an EtherNet/IP network, the following events occur for the controller to send data to the output module.

1. The controller broadcasts data to its local chassis at one of the following events:
   - RPI value
   - A programmed Immediate Output (IOT) instruction is executed.

     An IOT sends data immediately and resets the RPI timer.
2. The 1756 ControlLogix EtherNet/IP communication module in the local chassis broadcasts the data over the EtherNet/IP network.
3. After receiving the output data, the 1756 ControlLogix EtherNet/IP communication in the remote chassis broadcasts the data to its backplane, that is, the remote chassis.
4. The output module receives the data almost immediately after it is broadcast to the remote chassis backplane.

Listen-only Mode

Any controller in the system can listen to the data from any I/O module, that is, input data or 'echoed' output data, even if the controller does not own the module.

During the I/O configuration process, you can specify a 'Listen-Only' connection. For more information on Connection options when configuring your system, see page 125.

When you choose a 'Listen-Only' connection, the controller and module establish communication without the controller sending configuration data. In this instance, another controller owns the I/O module.

IMPORTANT	If any controller uses a 'Listen-Only' connection to the module, none of the other connections over the EtherNet/IP network can use the Unicast option. The 'Listen-Only' controller receives multicast data from the I/O module as long as a connection between a controller and I/O module is maintained If the connection between all owner-controllers and the module is broken, the module stops multicasting data and connections to all 'Listening controllers' are also broken.

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ControlLogix isolated analog input modules convert an analog signal to a digital value. The following are example analog signal types to which input modules convert to digital values:

- Volts
- Millivolts
- Milliamps
- Ohms

ControlLogix isolated analog output modules convert a digital value to an analog signal. The following are example analog signal types to which output modules convert digital values:

- Volts
- Milliamps

Common Analog I/O Features

The ControlLogix isolated analog I/O modules have the following features:

- CIP Sync Timestamp of Data
- Rolling Timestamp of Data
- Floating Point Data Format
- Module Resolution
- Calibration
- Fault and Status Reporting
- Configurable Software
- Latching of Alarms
- Module Inhibiting
- Electronic Keying

CIP Sync Timestamp of Data

The control system uses a 64-bit system clock. The modules support CIP Sync timestamping by using the 1588 protocol passed throughout the system. The 1588 protocol is defined in the IEEE 1588-2002 standard, publication Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems.

Each input channel scan or new output application is stamped with a CIP Sync timestamp and a single timestamp is returned to the controller for the module with the input data transfer.

You can use this feature for the following:

- To identify the sequence of events in fault conditions or during normal operation.

  It is possible to use the system clock between multiple modules in the same chassis or throughout a system in which a common Time Master is used.

- To measure the change between samples–which likely correlates closely with the RPI if no samples are missed in the logic–and to detect when a new sample is available for processing via the logic.

You can also use the 1588 Protocol to synchronize sampling for modules across the entire system. By using the Synchronized Sampling feature, described in detail on page 57 and page 81, you can configure multiple modules to coordinate their input samples precisely with each other when using the same RPI.

Synchronized Sampling lets you configure a test stand, for example, and take many measurements simultaneously across many modules, if needed, while still precisely coordinating the sampling. With these modules, the synchronized sampling should coordinate within approximately ± 20 μs.

Rolling Timestamp of Data

The rolling timestamp is a continuously running 16-bit rolling timestamp that counts in milliseconds from 0...32,767 ms; where 1 ms = 1 count.

Rolling Timestamp with the 1756-IF8I and 1756-IRT8I Modules

The 1756-IF8I and 1756-IRT8I modules scan their inputs at the RPI, update the input data, and update the rolling timestamp value. Other ControlLogix analog input modules scan their inputs at the RTS, not the RPI.

In either case, though, the controller program uses the last two rolling timestamp values to calculate the interval between the receipt of data or the time at which new data is received.

The rolling value is commonly used with instructions such as the PID and PIDE instructions. Every time a rolling timestamp changes, a PID or PIDE instruction is executed. When you configure a PID instruction for use with a 1756-IF8I and 1756-IRT8I module, set the loop update time equal to the module's RPI value.

Rolling Timestamp with the 1756-OF8I Module

For the 1756-OF8I module, the rolling timestamp value is updated only when new values are applied to the Digital to Analog Converter (DAC).

Floating Point Data Format

The modules return channel data to the owner-controller in the IEEE 32-bit floating point data format. In your Logix Designer application, the data type is REAL. You can configure the module to scan its channels and return data as quickly as every 1 ms.

The floating point data format lets you change the data representation of the selected channel. Although the full range of the module does not change, you can scale your module to represent I/O data in specific terms for your application.

When you scale a channel, you select two points that represent signal units, that is, a Low Signal and a High Signal. You also select two points that represent engineering units, that is, Low Engineering and High Engineering.

The Low Signal point equates to the Low Engineering point and the High Signal point matches the High Engineering point.

EXAMPLE

A 1756-IF8I module used in current mode maintains 0…21 mA range capability. Your application uses a 4…20 mA transmitter.

- If you want to receive values in **signal units**, configure the module as follows:
  - Low Signal = 4 mA
  - High Signal = 20 mA
  - Low Engineering = 4 EU
  - High Engineering = 20 EU
- If you want to receive values in terms of **Percent of Full Scale**, configure the module as follows:
  - Low Signal = 0 mA
  - High Signal = 20 mA
  - Low Engineering = 0%
  - High Engineering = 100%

By default, module channels used in Current mode are scaled such at 4...20 mA equate to 0...100% engineering units. Other module channels scale 1:1 with respect to signal units and engineering units by default.

Module Resolution

The modules support the following resolutions:

- 1756-IF8I and 1756-IRT8I modules – 24-bit resolution
- 1756-OF8I module – 16-bit resolution

For more information on module resolution, see page 35.

Module Quality Reporting

The modules indicate the quality of channel data returned to the owner-controller. Data quality represents accuracy. There are levels of data quality reported via module input tags.

The following input tags indicate the level of data quality. In the tag names, *x* represents the module channel number:

- *I.Ch[x].Fault* tag - This tag indicates that channel data can be completely inaccurate and cannot be trusted for use in the application. If the tag is set to 1, you cannot trust the data reported. You must troubleshoot the module to correct the cause of the inaccuracy.

  Common causes of inaccurate data include the following:
  - An overrange or underrange condition exists.
  - A wire off detection condition has occurred.
  - A short circuit detection condition has occurred.

- *I.Ch[x].Uncertain* tag - This tag indicates that channel data can be inaccurate but it is not known to what degree of inaccuracy. We recommend that you do not use the data for control.

  If the tag is set to 1, you know the data can be inaccurate but you must troubleshoot the module to discover what degree of inaccuracy exists.

  Common causes of uncertain data include the following:
  - The channel is actively being calibrated.
  - An invalid sensor offset value exists.
  - The channel's last data sample failed CRC while the most recent data sample was valid and used.

We recommend that you monitor these tags in your program to make sure the application is operating as expected with accurate channel input data.

Calibration

These modules use precise analog components that maintain their specifications over time. The modules are calibrated at the factory and recalibration is not required.

If desired, you can recalibrate the modules on a channel-by-channel or module-wide basis. For more information, see Calibrated Accuracy on page 38 if you choose to recalibrate the modules in the future.

Fault and Status Reporting

The modules provide fault and status data along with channel data. Faults are indicated via the status indicators on the front of the module as well as the module tags. Status data is available via the module tags.

- For more information on fault and status reporting via module tags, see the following:
  - 1756-IF8I fault and status reporting - page 64
  - 1756-IRT8I fault and status reporting - page 92
  - 1756-OF8I fault and status reporting - page 102
- For more information on fault reporting via status indicators, see Chapter 2, Troubleshoot Your Module on page 157

Configurable Software

Use one of the following software applications with your module:

- RSLogix 5000 software, versions 18...20
- Logix Designer application, version 21 or later

IMPORTANT	You must install Add-on Profiles (AOP) to use the modules in any Logix Designer application or RSLogix 5000 software project. This publication describes configuration with Logix Designer application. AOPs are available at: https://download.rockwellautomation.com/esd/download.aspx?downloadid=addonprofiles

All module feature configuration begins in the I/O configuration portion of the Logix Designer application. In addition to enable or disable module features, you can use the application to interrogate any module for the following module information:

- Serial number
- Revision information
- Catalog number
- Vendor identification
- Error/fault information
- Diagnostic counters

For more information on configurable software and its use, see the following sections:

- Preface
- Chapter 7, Configure ControlLogix Isolated Analog I/O Modules
- Chapter 8, Calibrate the ControlLogix Isolated Analog I/O Modules
- Chapter 9, Troubleshoot Your Module

Latching of Alarms

This feature latches a module alarm in the set position once the alarm is triggered. The alarm remains on, even if the condition causing it to occur disappears, until the alarm is unlatched.

IMPORTANT You must manually unlatch the alarm. You can unlatch the alarm, by using one of the following methods:

- While the project is online, click the Alarm Configuration tab on the Module. Then click Unlatch to unlatch a specific alarm or Unlatch All to unlatch all alarms.
- Change the module output tag for the alarm that you want to unlatch. For example, the *Ch[x].LLAlarmUnlatch* tag to unlatch a Low Low Alarm.

  For more information on module tags, see Appendix A, Isolated Analog I/O Module Tag Definitions on page 173.

- Use a CIP Generic message.

  For more information how to use a CIP Generic message, see Rockwell Automation Knowledgebase article #63046, How to Reset Latched Status of an Analog Module. You can access the article at: (Login required)

  https://rockwellautomation.custhelp.com/

To see where to latch alarms, see page 131 and page 133.

Module Inhibiting

This feature suspends the connection between an owner-controller and a module. This process can occur in either of the following ways:

- You write configuration for an I/O module but inhibit the module to prevent it from communicating with the owner-controller.

  In this case, the owner does not establish a connection and configuration is not sent to the module until the connection is uninhibited.

- A controller owns a module and has downloaded configuration to it. Data is currently being exchanged over the connection between the devices.

  In this case, when you inhibit the module and the owner-controller behaves as if the connection to the module does not exist.

IMPORTANT Whenever you inhibit an output module, it enters Program mode and all outputs change to the state configured for the Program mode. For example, if an output module is configured so that the state of the outputs go to zero (0) during Program mode, whenever that module is inhibited, the outputs go to zero (0).

The following examples are instances where you need to use module inhibiting:

- Multiple controllers own an analog input module. A configuration change is required. You must make the change in the program in all controllers.

  In this case, complete the following tasks.

  a. Inhibit the module.
  b. Change configuration in all controllers.
  c. Uninhibit the module.

- You want to upgrade the module. We recommend you complete the following tasks.

  a. Inhibit the module.
  b. Perform the upgrade.
  c. Uninhibit the module.

- The program includes a module that you do not physically possess and you do not want the controller to continually look for a module that does not exist.

  Inhibit the module until it physically resides in the proper slot.

To see where to inhibit a module connection, see page 126.

Electronic Keying

The electronic keying feature automatically compares the expected module, as shown in the I/O Configuration tree, to the physical module before I/O communication begins. You can use electronic keying to help prevent communication to a module that does not match the type and revision expected.

For each module in the I/O Configuration tree, the user-selected keying option determines if, and how, an electronic keying check is performed. Typically, three keying options are available:

- Exact Match
- Compatible Keying
- Disable Keying

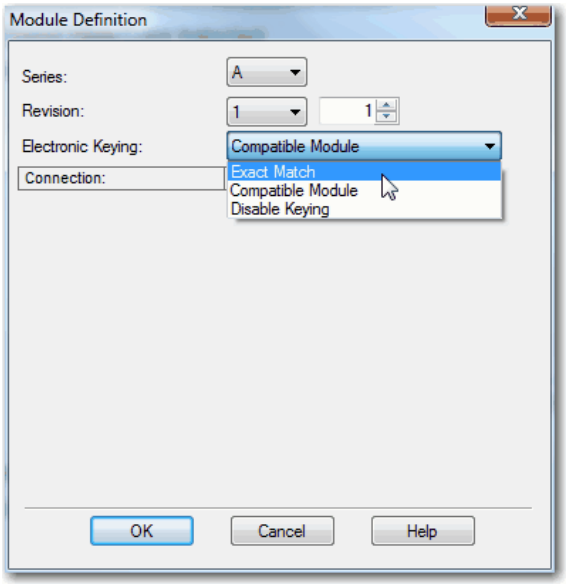
You must carefully consider the benefits and implications of each keying option when selecting between them. For some specific module types, fewer options are available.

Electronic keying is based on a set of attributes unique to each product revision. When a Logix5000 controller begins communicating with a module, this set of keying attributes is considered.

Attribute	Description
Vendor	The manufacturer of the module, for example, Rockwell Automation/Allen-Bradley.
Product Type	The general type of the module, for example, communication adapter, AC drive, or digital I/O.
Product Code	The specific type of module, generally represented by its catalog number, for example, 1756-IRT8I.
Major Revision	A number that represents the functional capabilities and data exchange formats of the module. Typically, although not always, a later, that is higher, Major Revision supports at least all of the data formats supported by an earlier, that is lower, Major Revision of the same catalog number and, possibly, additional ones.
Minor Revision	A number that indicates the module's specific firmware revision. Minor Revisions typically do not impact data compatibility but can indicate performance or behavior improvement.

You can find revision information on the Module Definition dialog box.

Figure 2 - Module Definition Dialog Box



IMPORTANT	Changing electronic keying selections online can cause the I/O communication connection to the module to be disrupted and can result in a loss of data.

Exact Match

Exact Match Keying requires all keying attributes, that is, Vendor, Product Type, Product Code (catalog number), Major Revision, and Minor Revision, of the physical module and the module created in the software to match precisely to establish communication. If any attribute does not match precisely, I/O communication is not permitted with the module or with modules connected through it, as in the case of a communication module.

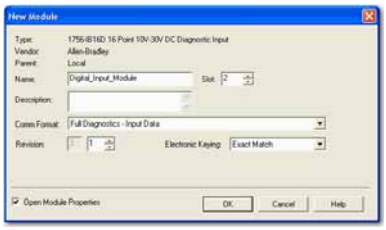
Use Exact Match keying when you need the system to verify that the module revisions in use are exactly as specified in the project, such as for use in highly-regulated industries. Exact Match keying is also necessary to enable Automatic Firmware Update for the module via the Firmware Supervisor feature from a Logix5000 controller.

EXAMPLE

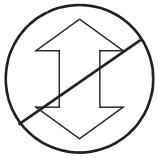
In the following scenario, **Exact Match keying prevents I/O communication**:

The module configuration is for a 1756-IB16D module with module revision 3.1. The physical module is a 1756-IB16D module with module revision 3.2. In this case, communication is prevented because the Minor Revision of the module does not match precisely.

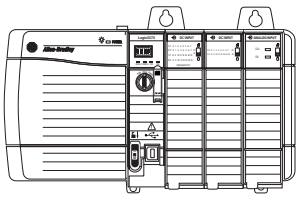
Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 1



Communication is prevented



Physical Module
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 2



IMPORTANT Changing electronic keying selections online can cause the I/O Communication connection to the module to be disrupted and can result in a loss of data.

Compatible Keying

Compatible Keying indicates that the module determines whether to accept or reject communication. Different module families, communication adapters, and module types implement the compatibility check differently based on the family capabilities and on prior knowledge of compatible products.

Compatible keying is the default setting. Compatible keying lets the physical module accept the key of the module configured in the software, provided that the configured module is one the physical module is capable of emulating. The exact level of emulation required is product and revision specific.

With Compatible keying, you can replace a module of a certain Major Revision with one of the same catalog number and the same or later, that is higher, Major Revision. In some cases, the selection makes it possible to use a replacement that is a different catalog number than the original. For example, you can replace a 1756-CNBR module with a 1756-CN2R module.

Release notes for individual modules indicate the specific compatibility details.

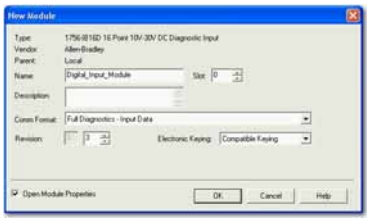
When a module is created, the module developers consider the module's development history to implement capabilities that emulate those of the previous module. However, the developers cannot know future developments. Because of this, when a system is configured, we recommend that you configure your module by using the earliest, that is, lowest, revision of the physical module that you believe will be used in the system. By doing this, you can avoid the case of a physical module rejecting the keying request because it is an earlier revision than the one configured in the software.

EXAMPLE

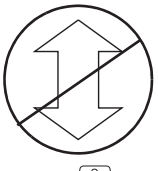
In the following scenario, **Compatible keying prevents I/O communication**:

The module configuration is for a 1756-IB16D module with module revision 3.3. The physical module is a 1756-IB16D module with module revision 3.2. In this case, communication is prevented because the minor revision of the module is lower than expected and.cant be incompatible with 3.3.

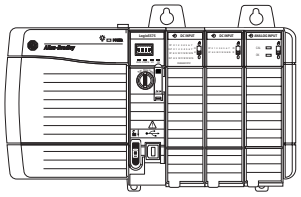
Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 3



Communication is prevented



Physical Module
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 2

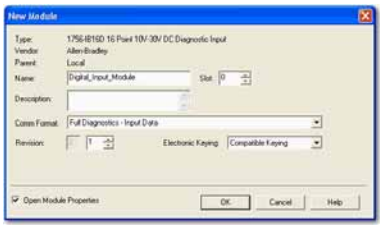


EXAMPLE

In the following scenario, **Compatible keying lets I/O communication occur**:

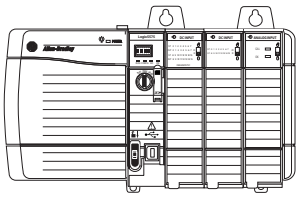
The module configuration is for a 1756-IB16D module with module revision 2.1. The physical module is a 1756-IB16D module with module revision 3.2. In this case, communication is allowed because the major revision of the physical module is higher than expected and the module determines that it is compatible with the prior major revision.

Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 2
Minor Revision = 1



Communication is allowed

Physical Module
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16D
Major Revision = 3
Minor Revision = 2



IMPORTANT Changing electronic keying selections online can cause the I/O communication connection to the module to be disrupted and can result in a loss of data.

Disabled Keying

Disabled Keying indicates the keying attributes are not considered when attempting to communicate with a module. Other attributes, such as data size and format, are considered and must be acceptable before I/O communication is established. With Disabled keying, I/O communication can occur with a module other than the type specified in the I/O Configuration tree with unpredictable results. We generally do not recommend using Disabled keying.

ATTENTION: Be extremely cautious when using Disabled keying; if used incorrectly, this option can lead to personal injury or death, property damage, or economic loss.

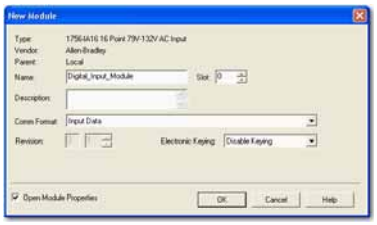
If you use Disabled keying, you must take full responsibility for understanding whether the module being used can fulfill the functional requirements of the application.

EXAMPLE

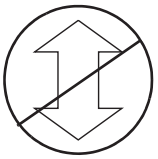
In the following scenario, **Disable keying prevents I/O communication**:

The module configuration is for a 1756-IA16 digital input module. The physical module is a 1756-IF16 analog input module. In this case, communication is prevented because the analog module rejects the data formats that the digital module configuration requests.

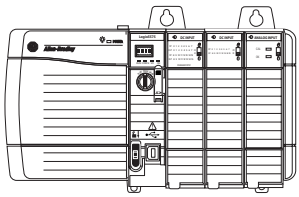
Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IA16
Major Revision = 3
Minor Revision = 1



Communication is prevented



Physical Module
Vendor = Allen-Bradley
Product Type = Analog Input Module
Catalog Number = 1756-IF16
Major Revision = 3
Minor Revision = 2

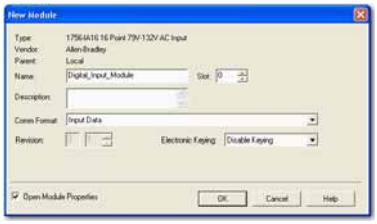


EXAMPLE

In the following scenario, **Disable keying lets I/O communication occur:**

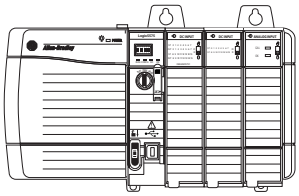
The module configuration is for a 1756-IA16 digital input module. The physical module is a 1756-IB16 digital input module. In this case, communication is allowed because the two digital modules share common data formats.

Module Configuration
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IA16
Major Revision = 2
Minor Revision = 1



Communication is allowed

Physical Module
Vendor = Allen-Bradley
Product Type = Digital Input Module
Catalog Number = 1756-IB16
Major Revision = 3
Minor Revision = 2



IMPORTANT Changing electronic keying selections online can cause the I/O communication connection to the module to be disrupted and can result in a loss of data.

To see where to configure Electronic Keying, see page 126.

Relationship between Module Resolution and Scaling

The following concepts must be explained in conjunction with each other:

- Module Resolution
- Scaling

Module Resolution

Resolution is the smallest degree of change that the module is capable of detecting. Module resolution represents a fixed number of counts across the module's **theoretical operating range**.

- 1756-IF8I and 1756-IRT8I modules support 24-bit resolution.

  The 24 bits represent 16,777,216 counts.

- 1756-OF8I module supports 16-bit resolution.

  The 16 bits represent 65,536 counts.

Resolution on Input Modules

The theoretical operating range is the full range across which the module can operate. For example, a 1756-IF8I module in Current mode has a theoretical operating range = -25.1...25.1 mA. The 24-bit resolution and 16,777,216 counts are available across 50.2 mA which yields our calculated 2.99 nA/count resolution.

However, when the 1756-IF8I module operates in Current mode, it is configured for an input range = 0...20 mA. This range limits the input to a 0...21 mA actual range capability.

The number of counts on a module is fixed. Module actual range capabilities, however, narrow operating ranges from the theoretical and result in supporting fewer counts. Using the example above, the 0...21 mA actual range capability represents 5,815,117 counts, that is, slightly more than 22.5 bits.

Divide the actual range capability by the number of counts in that range to determine the value of each count. The input range you choose during module configuration determines the value of each count. It does not determine the number of counts in that range. Therefore, module resolution across the usable input operating range is not always 24 bits.

Resolution on Output Module

The module resolution for the 1756-OF8I module is always 16 bits, regardless of operating mode and operating range.

The following table lists the resolution for each module's input/output range and corresponding range capability.

Table 2 - Module Resolution in Various Configuration Selections

Module	Mode	Available Input/ Output Range(1)	Actual Input/Output Range Capability	Number of Bits Across the Theoretical Operating Range	Number of Bits Across the Actual Range Capability	Resolution (signal per count)
1756-IF8I	Voltage	-10…10V 0…10V 0…5V	-10.5…10.5V 0…10.5V 0…5.25V	24 bits	23.75 22.75 21.75	1.49 µV/count
	Current	0…20 mA 0…20 mA (sourcing)	0…21 mA 0…21 mA (sourcing)		22.74	2.99 nA/count
1756-IRT8I	Thermocouple	-100…100 mV	-101…101 mV	24 bits	23.98	0.01 µV/count
	RTD	1…500 Ω 2…1000 Ω 4…2000 Ω 8…4000 Ω	0…510 Ω 0…1020 Ω 0…2040 Ω 0…4080 Ω		23.98	0.06 mΩ/count 0.12 mΩ/count 0.25 mΩ/count 0.50 mΩ/count
1756-OF8I	Voltage	-10…10V 0…10V 0…5V	-10.5…10.5V 0…10.5V 0…5.25V	16 bits	16.00	0.32 mV/count 0.16 mV/count 0.08 mV/count
	Current	0…20 mA	0…21 mA		16.00	0.32 µA

(1) These ranges represent the range choices available in the Logix Designer application.

IMPORTANT Because these modules must allow for possible calibration inaccuracies, resolution values represent the available Analog-to-Digital or Digital-to-Analog counts over the specified range.

Additionally, RPI and Notch Filter settings affect module resolution on the 1756-IF8I and 1756-IRT8I modules. For more information, see page 49 and page 68, respectively.

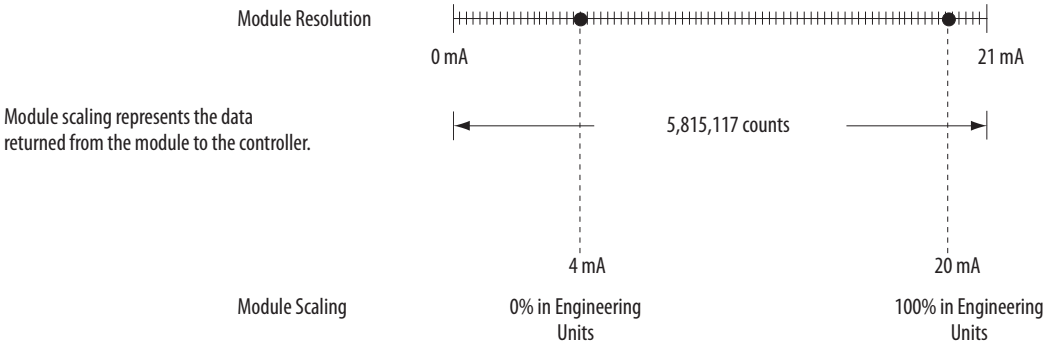
Scaling

When scaling, you choose two points along the module's operating range and apply low and high values to those points.

For example, if you are using the 1756-IF8I module in Current mode, the module supports a 0...21 mA actual range capability. But your application uses a 4...20 mA transmitter. Scaling lets you configure the module to return data to the controller so that a low signal value of 4 mA returns a low engineering value of 0% and a high signal value of 20 mA returns a high engineering value of 100%.

The returned engineering units value is indicated in the *I.Ch[x].Data* tag as shown in Table 3.

Figure 3 - Module Resolution Compared to Module Scaling



IMPORTANT In choosing two points for the low and high value of your application, you do not limit the range of the module. The module's range and its resolution remain constant regardless of how you scale it for your application.

The module can operate with values beyond the 4...20 mA range. If an input signal beyond the low and high signals is present at the module, for example, 0 mA, that data is represented in terms of the engineering units set during scaling.

The following table shows example values that can appear based on the example mentioned above.

Table 3 - Current Values Represented in Engineering Units

Current	Engineering Units Value	Value in I.Ch[*x*].Data Tag
0.0 mA	-25.00%	-25.00
4.0 mA	0.0%	0.00
12.0 mA	50.0%	50.0
20.0 mA	100.0%	100.0
21.0 mA	106.25%	106.25

Calibration

The ControlLogix isolated analog modules are calibrated via the following methods:

- Factory calibration when the modules are built.
- User-executed calibration as described in Chapter 8, Calibrate the ControlLogix Isolated Analog I/O Modules on page 137.

  User-executed calibration is optional.
- **1756-IRT8I module only** - Channels configured for Thermocouple inputs perform a lead resistance self-calibration when the module power is cycled.

Calibrated Accuracy

The **Calibrated Accuracy** specification represents the module's accuracy when its ambient temperature is the same as the temperature at which the module was calibrated.

The following specifications are related to Calibrated Accuracy:

- Calibrated Accuracy at 25 °C (77 °F)
- Module Error over Full Temperature Range

Calibrated Accuracy at 25 °C (77 °F)

This specification matches the temperature at which the module was calibrated in the factory during manufacturing.

The module's accuracy when operating in 25 °C (77 °F) conditions = 0.05%.

Module Error over Full Temperature Range

The Module Error Over Full Temperature Range specification represents the error that occurs if the module's ambient temperature changes a total of 60 °C (140 °F), that is, from 0...60 °C (32...140 °F) or 60...0 °C (140...32 °F).

The module accuracy over the full temperature range = 0.1%.

Error Calculated over Hardware Range

A ControlLogix isolated analog I/O module's calibration accuracy at 25 °C (77 °F) is calculated over the full hardware range of the module and is not dependent on the application's use of the range. The error is the same if you are measuring it across a 10% or 100% portion of a given range.

However, a module's accuracy at 25 °C (77 °F) is dependent on the hardware range in which the module operates.

EXAMPLE	When the 1756-IRT8I channel uses the Thermocouple (mV) input type, the input range is -100 . . . 100 mV, the module error is 0.2 mV when using 0.1% of range accuracy. These error values are the same whether you use 10% or 100% of the chosen range.

RTD and Thermocouple Error Calculations

When you use the 1756-IRT8I module in temperature mode, error calculations are achieved by a two-step process.

1. Calculate the module's error in ohms or volts.
2. Convert the ohm/volt error to temperature for the specific sensor and at the correct application temperature.

RTD Error

Module error on the 1756-IRT8I module used with an RTD input is defined in ohms. The error is calculated across the entire input range selected, not the available range of a sensor used with the module. For example, if the 1...500 Ω input range is used, the module error is calculated across 510 Ω (actual range = 0...510 Ω).

The error in ohms translates to temperature, but that translation varies because the relationship is non-linear. The most effective way to check 1756-IRT8I module error is to calculate the error in ohms and use that value in a linearization table to check the temperature error.

If the module is calibrated at operating temperature and the operating temperature remains relatively stable, calibration accuracy is better than 0.05% of the full range. This 0.05% value is a worst case value. In other words, with the 1...500 Ω input range selected, the worst case module error is 0.255 Ω

Finally, you must check an RTD linearization table to determine how the temperature error of 0.510 Ω translates.

For example, if the 1756-IRT8I has a 0.05% (or 0.255 Ω) error and is at a temperature of 0 °C (32 °F), the temperature error is ±0.65 °C (±1.17 °F) when the Platinum 385 sensor type is used. This same error at a temperature of 200 °C (392 °F) translates to a temperature error of ±0.69 °C (±1.26 °F).

Thermocouple Error

Thermocouple error at 25 °C (77 °F) indicates the module's accuracy in measuring temperature. This accuracy varies depending on these factors:

- Input range = -100...100 mV.
- Thermocouple sensor type, any of the following:
  - Type B
  - Type C
  - Type D
  - Type E
  - Type J
  - Type K (default value)
  - Type N
  - Type R
  - Type S
  - Type T
  - Type TXK/XK (L)
- Application temperature, that is, the temperature of the physical location where the thermocouple is being used.

EXAMPLE

When a 1756-IRT8I module is used with a thermocouple input type in the following conditions, module error at 25 °C (77 °F) is ±3.74 °:

- Connected to a type S thermocouple
- Application temperature of 1200 °C (2192 °F)

In other words, the difference between the temperature the module reports and the actual application temperature can be ±3.74 °.

The module can report an application temperature of 1200 ° C (2192 °F) in this case when the actual temperature can be in the range from 1196.26…1203.74 °C (2185.268…2198.732 °F).

These calculations used a typical error of 0.02% of full scale range.

Module Error at 25 °C (77 °F)

Table 4 lists the 1756-IRT8I module error at 25 °C (77 °F) when using a thermocouple input type.

Table 4 - 1756-IRT8I Module Error At 25 °C (77 °F) with Thermocouple Input Type

Application Temperature	Module Error at 25 °C (77 °F) When Connected to Thermocouple Types										
	Type B	Type C	Type D	Type TXK/ XK(L)	Type R	Type S	Type E	Type J	Type K	Type N	Type T
-200 °C (-328 °F)				1.65			1.79	2.06	2.95	4.53	2.86
0 °C (32 °F)		3.46	4.59	0.93	8.51	8.33	0.77	0.89	1.14	1.72	1.16
200 °C (392 °F)		2.65	2.83	0.71	5.09	5.32	0.61	0.81	1.13	1.36	0.85
400 °C (752 °F)	11.08	2.37	2.36	0.62	4.34	4.70	0.56	0.82	1.07	1.21	0.73
600 °C (1112 °F)	7.56	2.37	2.22	0.56	3.96	4.41	0.56	0.77	1.06	1.16	
800 °C (1472 °F)	5.89	2.37	2.20	0.51	3.65	4.14	0.57	0.70	1.10	1.15	
1000 °C (1832 °F)	4.93	2.37	2.25		3.40	3.90	0.60	0.76	1.15	1.17	
1200 °C (2192 °F)	4.35	2.65	2.36		3.23	3.74		0.79	1.23	1.21	
1400 °C (2552 °F)	3.99	2.81	2.47		3.18	3.71			1.33		
1600 °C (2912 °F)	3.85	3.00	2.63		3.24	3.80					
1800 °C (3272 °F)	3.92	3.46	2.85		3.67	4.36					
2000 °C (3632 °F)		3.75	3.19								
2200 °C (3992 °F)		4.09	3.95								

IMPORTANT When calculating total measurement error, module error at 25 °C (77 °F) is only one factor in deriving the total measurement error budget.

Other factors that impact thermocouple measurement error include the following:

- Thermocouple sensor accuracy/error
- Conditions of thermocouple wire, such as wire length
- Cold junction compensation values

Thermocouple Resolution

Thermocouple resolution indicates the degrees that an application temperature must change before the 1756-IRT8I module connected to a thermocouple module reports a change. Resolution depends on the following factors:

- Thermocouple sensor type, any of the following:
  - Type B
  - Type C
  - Type D
  - Type E
  - Type J
  - Type K (default value)
  - Type N
  - Type R
  - Type S
  - Type T
  - Type TXK/XK (L)
- Application temperature, that is, the temperature of the physical location where the thermocouple is being used.

EXAMPLE

For example, when a 1756-IRT8I module is used with a thermocouple input type in the following conditions, module resolution is 0.01 °:

- Input channel is connected to a type K thermocouple
- Application temperature is 400 °C (752 °F)

In other words, the application temperature must change by 0.01 ° or greater for the 1756-IRT8I module used with a thermocouple input to record a change. If the temperature stays in a range from 399.991…400.009 °C (751.984…752.016 °F), the module continues to report an application temperature of 400 °C (752 °F).

Table 5 lists the 1756-IRT8I module resolution when using a thermocouple input type.

Table 5 - 1756-IRT8I Module Resolution in Degrees C with Thermocouple Input Type

Application Temperature	Module Resolution (in degrees C) When Connected to This Thermocouple Type										
	Type B	Type C	Type D	Type TXK/XK(L)	Type R	Type S	Type E	Type J	Type K	Type N	Type T
-200 °C (-328 °F)				0.02			0.02	0.02	0.03	0.04	0.03
0 °C (32 °F)		0.03	0.05	0.01	0.08	0.08	0.01	0.01	0.01	0.02	0.01
200 °C (392 °F)		0.03	0.03	0.01	0.05	0.05	0.01	0.01	0.01	0.01	0.01
400 °C (752 °F)	0.11	0.02	0.02	0.01	0.04	0.05	0.01	0.01	0.01	0.01	0.01
600 °C (1112 °F)	0.07	0.02	0.02	0.01	0.04	0.04	0.01	0.01	0.01	0.01	
800 °C (1472 °F)	0.06	0.02	0.02	0.01	0.04	0.04	0.01	0.01	0.01	0.01	
1000 °C (1832 °F)	0.05	0.02	0.02		0.03	0.04	0.01	0.01	0.01	0.01	
1200 °C (2192 °F)	0.04	0.03	0.02		0.03	0.04		0.01	0.01	0.01	
1400 °C (2552 °F)	0.04	0.03	0.02		0.03	0.04			0.01		
1600 °C (2912 °F)	0.04	0.03	0.03		0.03	0.04					
1800 °C (3272 °F)	0.04	0.03	0.03		0.04	0.04					
2000 °C (3632 °F)		0.04	0.03								
2200 °C (3992 °F)		0.04	0.04								

1756-IF8I Isolated Analog Input Module

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Module Block and Circuit Diagrams	58
Wire the 1756-IF8I Module	61
Fault and Status Reporting	64

The 1756-IF8I module has eight isolated channels. Each channel supports connection to the following input types:

- Current
- Voltage

The module provides 24-bit resolution and uses differential inputs. Differential input have a greater resistance to the effects of electromagnetic noise and provide improved flexibility with respect to cable length when wiring your module.

Additional features are described in this chapter.

1756-IF8I Module Features

The 1756-IF8I module has the following features:

- Internal Loop Power Source
- Multiple Input Ranges
- Notch Filter
- Underrange/Overrange Detection
- Digital Filter
- Process Alarms
- Rate Alarm
- Sensor Offset
- Wire Off Detection
- Synchronized Sampling

IMPORTANT Most of the features available on the 1756-IF8I module are software configurable. For more information on how to configure the module, see Chapter 7, Configure ControlLogix Isolated Analog I/O Modules on page 121

Internal Loop Power Source

The 1756-IF8I module offers a software user-configurable selection for an internal loop power source on each channel. You must use the Current input type and enable Source Loop Current to use an internal power source on the channel.

The source is current limited to ~45 mA and lets the module power a two-wire transmitter directly without the need for an external power supply.

A sourcing overcurrent condition typically occurs due to a short between terminals on the module. With this module the short is between terminals IN_*x*/I/SRC and RTN_*x* (where *x* is the channel number).

If a Sourcing overcurrent condition exists, the 1756-IF8I module sets the input to 24 mA, that is, the equivalent engineering unit value. This value indicates a special error condition beyond the normal Overrange value, that is, 21 mA:

- For one second, the overcurrent condition self-corrects if the condition trigger is removed.
- After one second, the condition latches, the channel disables Source Loop Current and continues to send 24 mA with an Overrange indication.

  The following are examples of events that unlatch the condition:
  - Power is cycled to the module.
  - The module is reset.
  - The controller connection to the module is inhibited and then uninhibited.
  - New configuration is downloaded from the controller.

The transmitter varies the current to the analog input in proportion to the process variable being measured. The inclusion of an internal on-board loop power source saves you the expense of extra power supplies and greatly simplifies the interface wiring to field devices. Each channel on the module provides independent, isolated, current-limited power to its current transmitter.

In addition to supplying loop power to two-wire transmitters, the module can also accommodate current transmitters powered by an external supply. The module accommodates two-wire and four-wire transmitters when configured for Current input type and Source Loop Current is disabled.

Power Calculations with the 1756-IF8I Module

The module's 24V backplane current requirements increase when it operates with a Current input type and Source Loop Current mode enabled.

The 1756-IF8I module uses the power provided across the ControlLogix chassis backplane as the source for loop power. Because of the demands placed on that supply, that is, the 1756-IF8I module consumes 10.6 W of backplane power, take special care when calculating the power requirements for modules in the same chassis as a 1756-IF8I module.

For example, when used with the 1756-L75 controller and operating in the Sourcing Loop Current mode, you can place only six 1756-IF8I modules in the chassis before exceeding the wattage capacity of the power supply.

Other Devices in the Wiring Loop

The voltage source on each channel can drive loop impedance of up to approximately 1300 Ω. This lets you include other devices, such as chart recorders and meters, in the current loop.

For more information on wiring the 1756-IF8I module, see page 61.

Multiple Input Ranges

The 1756-IF8I module offers multiple input ranges that are dictated by channel configuration choices. The input type selection determines the available ranges.

Input Type	Input Range
Current (mA)	0…20 mA
Voltage (V)	Any of the following: • -10…10V • 0…5V • 0…10V

To see where to select the input range, see page 127.

Notch Filter

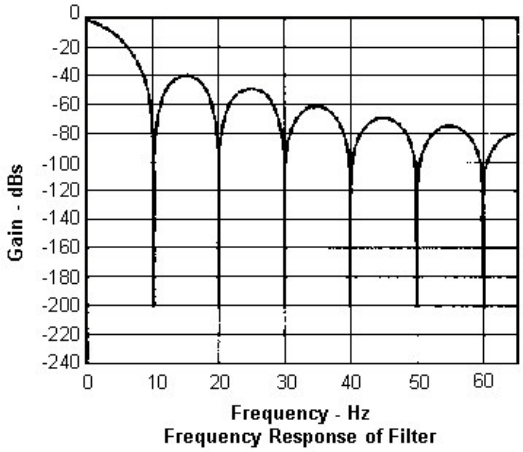
The notch filter is a built-in feature of the Analog-to-Digital convertor (ADC) that removes line noise in your application for **each channel**. The removal of line noise is also known as noise immunity.

The notch filter attenuates the input signal at the specified frequency. That is, the filter reduces the amplitude of the signal with minimal signal distortion.

Choose a notch filter based on what noise frequencies are present in the module's operating environment and any sampling requirements needed for control. The default Notch Filter setting is 60 Hz.

For example, a notch filter is typically set to 60 Hz to filter out 60 Hz AC line noise and its overtones. A 60 Hz notch filter setting attenuates frequencies of 60 Hz, 120 Hz, 180 Hz and so forth.

The following graphic shows 10 Hz notch filter selection and how the noise is dissipated over the entire spectrum but especially at the notch filter setting and its overtones.



Frequency Response of Filter

Relationship between Noise Rejection Level and RPI Setting

The 1756-IF8I module offers two levels of line noise rejection. Each level has a filter associated with it. The module automatically determines which filter is used based on the notch filter setting and RPI rate.

A trade-off exists between sampling speed and level of noise rejection:

- The faster the sampling speed, the less noise rejection. In this case, the module automatically uses a SINC^1 filter.

  The SINC^1 filter offers 34 dB noise rejection at the notch filter frequency and its overtones.

- The slower the sampling rate, the better noise rejection. In this case, the module automatically uses a SINC^3 filter.

  The SINC^3 filter offers 100 dB noise rejection at the notch filter frequency and its overtones.

The following table lists the available notch filter settings, the minimum RPI rate available with that notch filter setting, and the corresponding noise response.

Notch Filter Setting	**5 Hz**	**10 Hz**	**15 Hz**	**20 Hz**	**50 Hz**	**60 Hz (Default)**	**100 Hz**	**500 Hz**	**1000 Hz**	**5000 Hz**
Minimum Sample Time (RPI) - SINC^1 Filter(1)	200.1 ms	100.1 ms	66.7 ms	50.1 ms	20.1 ms	16.7 ms	10.1 ms	2.1 ms	1.1 ms	1.0 ms
Minimum Sample Time (RPI) - SINC^3 Filter(1)	600.1 ms	300.1 ms	200.1 ms	150.1 ms	60.1 ms	50.1 ms	30.1 ms	6.1 ms	3.1 ms	1.0 ms
0…100% Step Response Time(2)(3)	600 ms + 1RPI	300 ms + 1RPI	200 ms + 1RPI	150 ms + 1RPI	60 ms + 1RPI	50 ms + 1RPI	30 ms + 1RPI	6 ms + 1 RPI	3 ms + 1RPI(4)	1 ms + 1RPI(4)
-3 dB Frequency(2)	1.3 Hz	2.7 Hz	4.3 Hz	5.1 Hz	13 Hz	15 Hz	26 Hz	128 Hz	258 Hz	1296 Hz
Typical Effective Resolution(2)	21 bits	20 bits	20 bits	20 bits	20 bits	20 bits	19 bits	18 bits	18 bits	17 bits

(1) The minimum RPI value for the module depends on the channel with the lowest notch filter setting. For example, if three of the channels on a module use a Notch Filter setting of 20 Hz and one channel uses a Notch Filter setting of 60 Hz, you cannot set the module RPI lower than 50.1 ms.

(2) Using the SINC^3 filter.

(3) Worst case settling time to 100% of step change includes 0…100% step response time plus one RPI sample time.

(4) Value represents module performance in Current mode. For the value when the module is used in Voltage mode, include additional 3 ms settling time due to RC time constant of 7500 Ω voltage input resistor.

For example, if your application requires a Notch Filter setting of 50 Hz, the module's minimum RPI rate is 20.1 ms. In this case, sampling speed is more important than noise rejection. The module automatically uses a SINC^1 filter.

If your application requires a Notch Filter setting of 50 Hz and the greater level of noise rejection provided by a SINC^3 filter, the minimum RPI rate is 60.1 ms. The module automatically uses a SINC^3 filter.

The RPI must be > 1/Notch Filter plus some small scan time for the ADC to sample properly. The SINC^3 filter takes 3 times as long and thus requires RPI > 3/Notch plus some small scan time. The module rejects combinations which violate that relationship.

The table below lists the available notch filter settings and the RPI values for the two types of filters.

Notch Filter	Fastest RPI for a SINC^1 Filter	Fastest RPI for a SINC^3 Filter
5 Hz	200.1 ms	600.1 ms
10 Hz	100.1 ms	300.1 ms
15 Hz	66.7 ms	200.1 ms
20 Hz	50.1 ms	150.1 ms
50 Hz	20.1 ms	60.1 ms
60 Hz (default)	16.7 ms	50.1 ms
100 Hz	10.1 ms	30.1 ms
500 Hz	2.1 ms	6.1 ms
1000 Hz	1.1 ms	3.1 ms
5000 Hz	1.0 ms	1.0 ms

To see where to set the Notch Filter, see page 127.

Underrange/Overrange Detection

This feature detects when the isolated input module is operating beyond limits set by the input range. For example, if you are using the 1756-IF8I module in the 0...10V input range and the module voltage increases to 11V, the overrange feature detects this condition.

The following table lists the input ranges of the 1756-IF8I module and the lowest/highest signal available in each range before the module detects an underrange/overrange condition.

Input Type	Range	Underrange Threshold	Overrange Threshold
Current (mA)	0…20 mA	≤ 3.6 mA(1) (2)	≥ 21.00 mA(3)
Voltage (V)	±10.00V	≤ -10.50	≥10.50
	0…10V	≤ 0.00V	≥10.50
	0…5V	≤ 0.00V	≥ 5.25V

(1) Underrange is set at 3.6 mA, but the *I:Ch[x].Data* tag reports values as low as 0.0 mA.

(2) When used with a Current input type, the module has an inherent deadband. Once latched, an Underrange condition continues until the signal is greater than 3.8 mA.

(3) When used with a Current input type, the module has an inherent deadband. Once latched, an Overrange condition continues until the signal is less than 20.75 mA.

IMPORTANT

Be aware that the Disable All Alarms feature, does not disable the underrange/overrange detection feature. The Disable All Alarms feature disables all alarms on the module.

The underrange/overrange detection feature is not an alarm. It is an indicator that channel data has gone beyond the absolute maximum or minimum, respectively, for the channel's chosen range but does not trigger an alarm.

To disable the underrange/overrange detection feature, you must disable the channel.

To see where to set the Underrange/Overrange detection values, see page 131.

Digital Filter

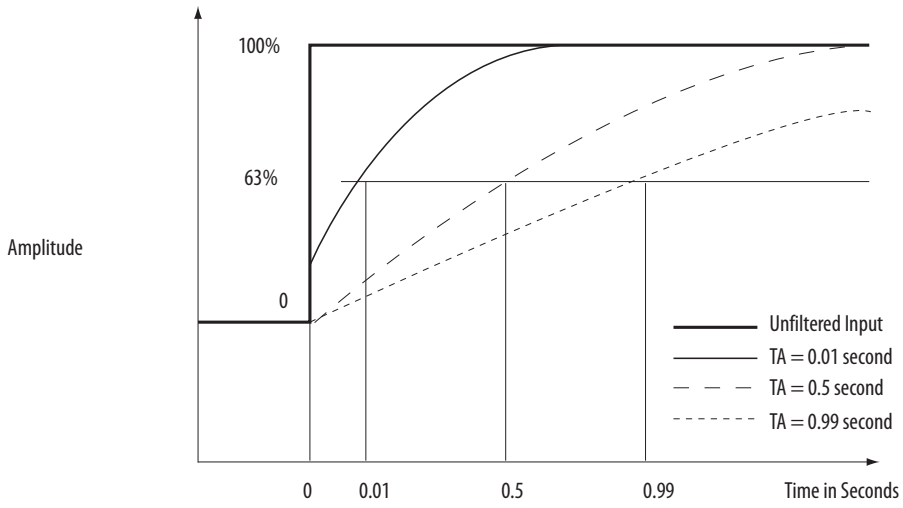
The digital filter smooths input data noise transients on **each input channel**. This value specifies the time constant for a digital, first-order lag filter on the input. It is specified in units of milliseconds. A value of 0 (zero) disables the filter.

The digital filter equation is a classic, first order lag equation.

$$Y_n = Y_{n-1} + \frac{[\Delta t]}{\Delta t + TA} X_n - Y_{n-1}$$

Y_n = Present output, filtered peak voltage (PV)'
Y_{n-1} = Previous output, filtered PV
Δt = Module channel update time (seconds)
TA = Digital filter time constant (seconds)
X_n = Present input, unfiltered PV

As shown in the following graphic, by using a step input change to illustrate the filter response, you see that 63.2% of the total response is reached when the digital filter time constant elapses. Each additional time constant achieves 63.2% of the remaining response.



To see where to set the Digital Filter, see page 127.

Process Alarms

Process alarms alert you when the module has exceeded configured high or low limits for **each channel**. These are set at four, user-configurable, alarm trigger points:

- High high
- High
- Low
- Low low

You can enable or disable Process Alarms individually via the Output tags for each channel. When a module is added to your Logix Designer application project and tags are created, the Alarms are disabled by default.

Each individual Process Alarm enable tag, that is, *O.Ch[x].LLAlarmEn, O.Ch[x].LAlarmEn, O.Ch[x].HAlarmEn and O.Ch[x].HHAlarmEn*, is disabled when the module is created. You must enable the tags in the Output Data to allow the individual alarm to trigger.

If a Process Alarm's enable bit is not set, the corresponding Input Process Alarm never triggers. To see where to set the Process Alarms, see page 131.

You can latch process alarms. The alarm remains on, even if the condition causing it to occur disappears, until the alarm is unlatched.

IMPORTANT You must manually unlatch the alarm. You can unlatch the alarm, by using one of the following methods:

- While the project is online, click the Alarm Configuration tab on the Module. Then click Unlatch to unlatch a specific alarm or Unlatch All to unlatch all alarms.
- Change the module output tag for the alarm that you want to unlatch. For example, the *Ch[x].LLAlarmUnlatch* tag to unlatch a Low Low Alarm.

  For more information on module tags, see Appendix A, Isolated Analog I/O Module Tag Definitions on page 173.

- Use a CIP Generic message.

  For more information how to use a CIP Generic message, see Rockwell Automation Knowledgebase article #63046, How to Reset Latched Status of an Analog Module. You can access the article at:

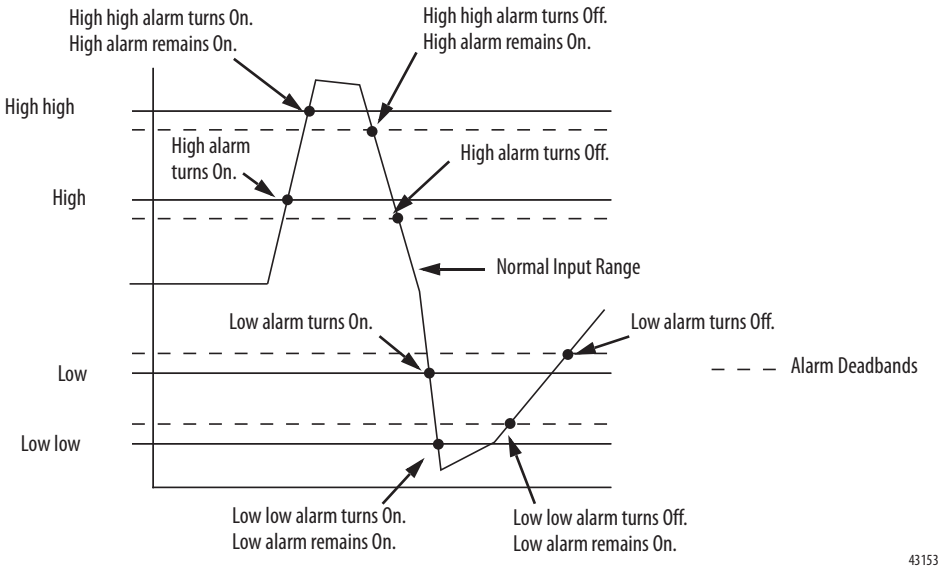
  https://rockwellautomation.custhelp.com/

Alarm Deadband

You can configure an alarm deadband to work with these alarms. The deadband lets the process alarm status bit remain set, despite the alarm condition disappearing, as long as the input data remains within the deadband of the process alarm.

The following graphic shows input data that sets each of the four alarms at some point during module operation. In this example, latching is disabled; therefore, each alarm turns Off when the condition that caused it to set ceases to exist.

Figure 4 - Alarm Deadband Alarm Settings



To see where to set the Alarm Deadband, see page 131.

Rate Alarm

The rate alarm triggers if the rate of change between input samples for **each channel** exceeds the specified trigger point for that channel. The actual rate of change for the last sample is returned in the *Ch[x].RateOfChange* input tag of each channel.

EXAMPLE

If scaling mA to mA, if you configure a channel's rate alarm to 1.0 mA/s, the rate alarm triggers only if the difference between measured input samples changes at a rate > 1.0 mA/s.

Consider the following conditions:

- The module's RPI is 100 ms, that is, new data is sampled every 100 ms.
- At **input sample 1**, the channel measures 5.0 mA.
- At **input sample 2**, (100 ms later) the channel measures 5.08 mA.

  At this sample instance, the **rate alarm is not triggered** because the rate of change is less than 1.0 mA/s.

  The rate of change is 0.8 mA/s [(5.08 mA - 5.0 mA) / (100 ms)].
- At **input sample 3** (100 ms later) the channel measures 4.9 mA.

  At this sample instance, the **rate alarm is triggered** because the rate of change is greater than 1.0 mA/s.

  The rate of change is 1.8 mA/s. [(4.9 mA - 5.08 mA) / (100 ms)].

  At this sample instance, the absolute value of this result is > 1.0 mA/s, so the rate alarm sets. Absolute value is used because rate alarm checks for the magnitude of the rate of change being beyond the trigger point, whether a positive or negative excursion.

To see where to set the Rate Alarm, see page 131.

Sensor Offset

The sensor offset compensates for any known error on the sensor or channel to which the sensor is connected. The value is set in signal units and is added to the data value.

For example, if the sensor has an error such that the channel consistently reports current signal values by 0.2 mA lower than actual the value, you set this parameter to 0.2 in channel configuration.

You set this value via a module output tags. That is, tag *O.Ch[x].SensorOffset*. Where x represents the module channel.

In the example above, the *O.Ch[x]SensorOffset* tag = 0.2.

Wire Off Detection

The 1756-IF8I module alerts you when a wire is disconnected from a channel or the RTB is removed from the module. The following events occur when a wire off condition exists:

- Module Operating in **Voltage Mode**
  - Input data for that channel changes to a specific scaled value corresponding to the Overrange value.
  - The Overrange bit is set in the *I:Ch[x].Overrange* tag.
- Module Operating in **Current Mode**
  - Input data for that channel changes to a specific scaled value corresponding to the Underrange value.
  - The Underrange bit is set in the *I:Ch[x].Underrange* tag.
- A fault bit is set in the owner-controller that can indicate the presence of a wire off condition.

IMPORTANT Be aware that the Disable All Alarms feature, does not disable the wire off detection feature. The Disable All Alarms feature disables all alarms on the module.

The wire off detection feature is not an alarm. It is an indicator that a wire has been disconnected from the channel but does not trigger an alarm.

To disable the wire off detection feature, you must disable the channel.

Because the module can be used in voltage or current applications, differences exist as to how a wire off condition is detected in voltage or current applications.

Table 6 - 1756-IF8I Module - Wire Off Conditions in Different Applications

Application Configuration	Wire Off Condition Cause	Resulting Module Behavior
Voltage Applications	Either of the following: • A wire is disconnected from the module. • The RTB is disconnected from the module.	• Input data for that channel changes to the scaled value associated with the **overrange** signal value of the selected operational range. • The *I.Ch[x].Overrange* (x=channel number) tag is set to 1.
Current Applications		• Input data for that channel changes to the scaled value associated with the **underrange** signal value of the selected operational range. • The *I.Ch[x].Underrange* (x=channel number) tag is set to 1.

Synchronized Sampling

This feature lets you synchronize input sampling across inputs on multiple modules in the same chassis, forcing those inputs to sample simultaneously within approximately 20 µS of each other.

IMPORTANT	Synchronized Sampling is not limited to input sample across inputs on the same module types. You can use Synchronized Sampling across inputs on 1756-IF8I modules and 1756-IRT8I modules in the same system.

For example, if you have 12 input devices connected to one 1756-IF8I module and two 1756-IRT8I modules in the same chassis, or different chassis synchronized to the same CIP Sync TimeMaster, use Synchronized Sampling to take a snapshot of the input data available at each input at a single moment in time.

The following conditions must exist to use this feature:

- A 1588 CIP Sync Time Master is configured for the chassis.
- All modules in the set use the same RPI value or values that are multiples of each other.
- Synchronized Sampling with Other Synchronized Modules is enabled for all input channels in the set.

  For these input modules, configuring one channel for Synchronized Sampling synchronizes all eight channels.

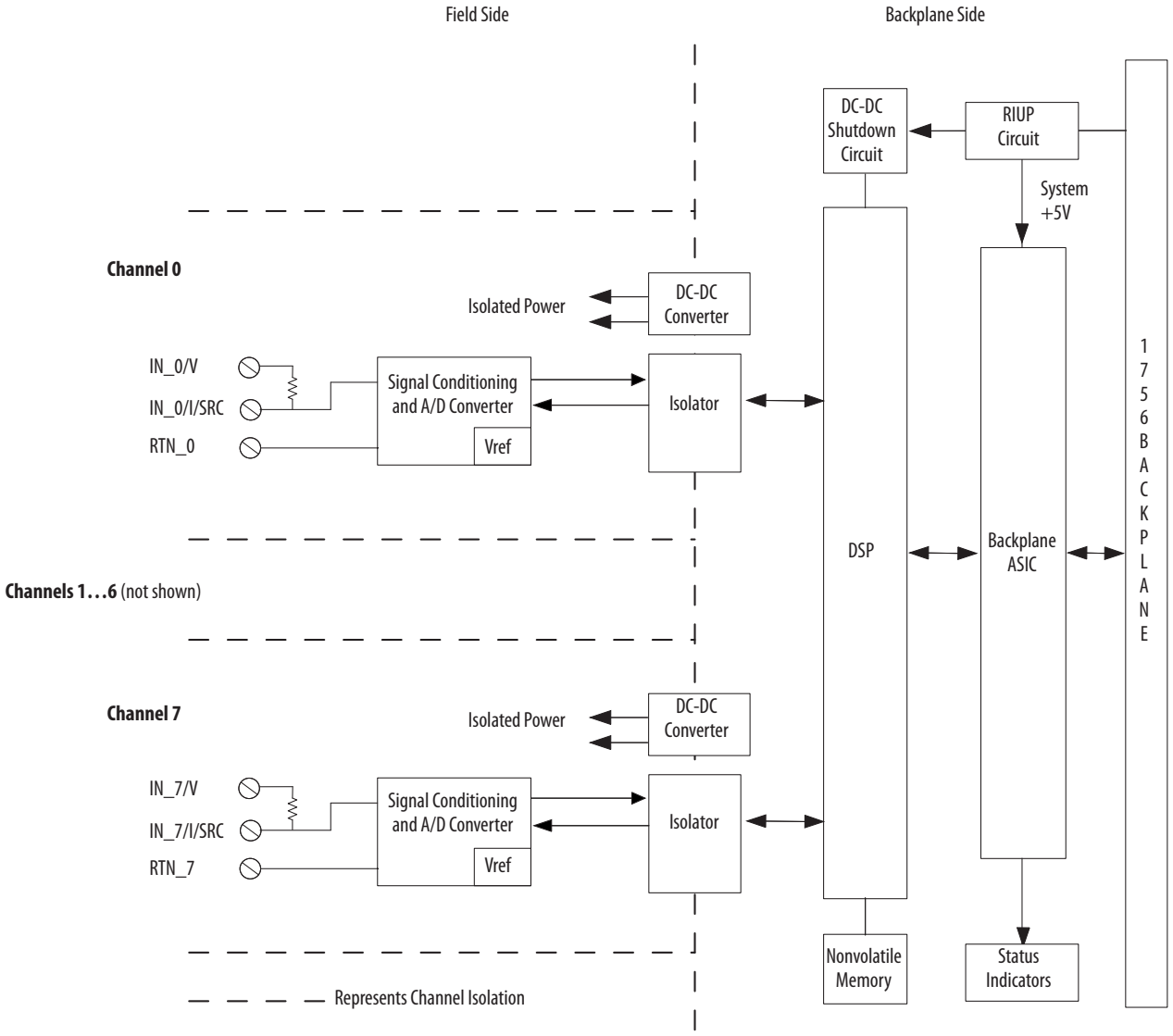
While setting the RPI to the same value on all 1756-IF8I modules guarantees that each module samples at the same rate, it does not guarantee that they sample at the same time. When enabled, Synchronized Sampling provides each module a synchronized starting point for its respective input scans. Because the RPI values are the same, the inputs on the modules are sampled at the same rate and the same time.

To see where to enable Synchronized Sampling, see page 127.

Module Block and Circuit Diagrams

The graphics in this section show the 1756-IF8I module's block diagrams and field-side circuit diagrams.

Figure 5 - 1756-IF8I Module Block Diagram



Field-side Circuit Diagrams

The following diagrams show the field-side circuitry for the 1756-IF8I module.

Figure 6 - 1756-IF8I Module Field-side Circuit with Voltage Input

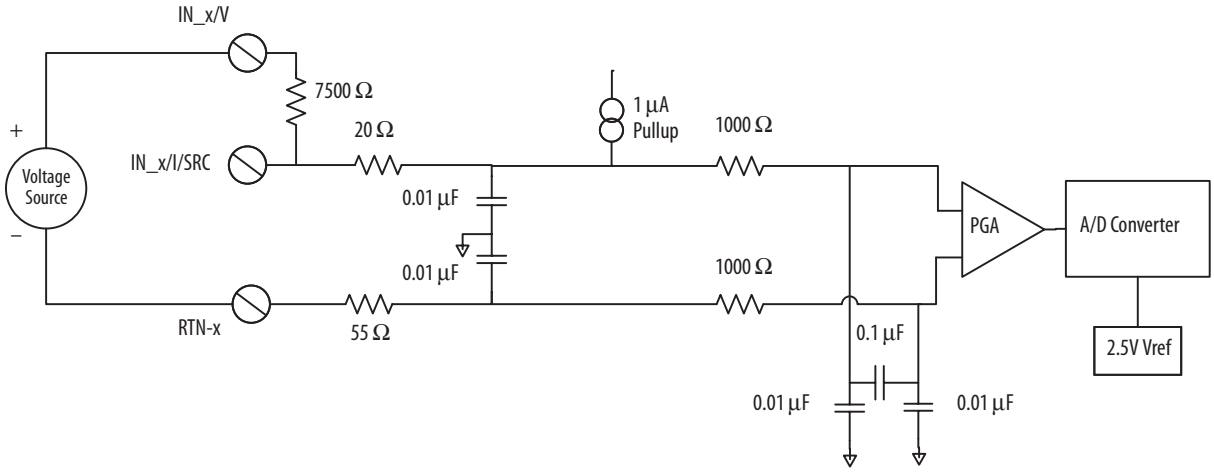


Figure 7 - 1756-IF8I Input Module Field-side Circuit with an Externally-powered Current Input Loop

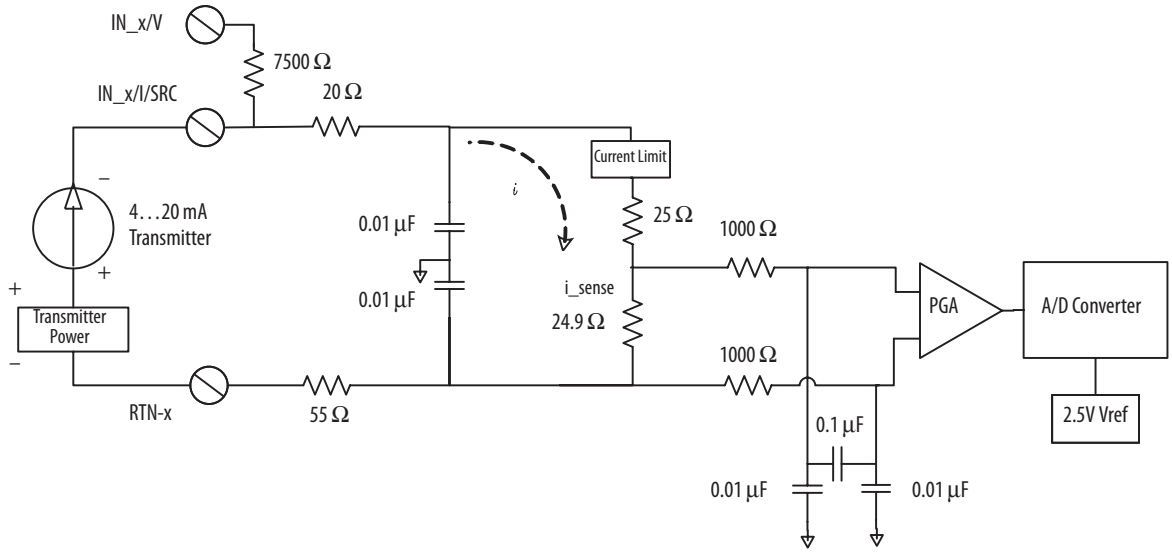
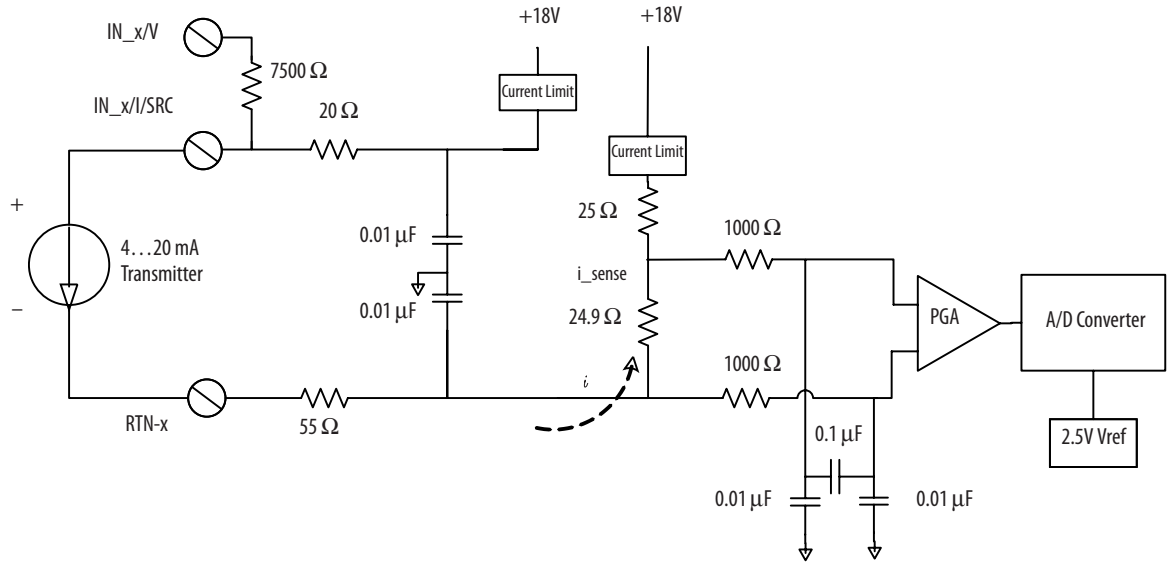


Figure 8 - 1756-IF8I Module Field-side Circuit with the Module Sourcing the Current Input Loop



Wire the 1756-IF8I Module

This section shows how to wire the 1756-IF8I module for current and voltage input types.

Figure 9 - 1756-IF8I Module Wiring Diagram -Current Mode with External Loop Power

IMPORTANT In this wiring diagram, an external, user-provided power supply provides 24V DC loop power.

IMPORTANT: Remember the following:

- If separate power sources are used, do not exceed the specific isolation voltage. For more information on module specifications, see the 1756 ControlLogix I/O Specifications Technical Data, publication 1756-TD002.
- Place additional loop devices, for example, strip chart recorders, at either 'A' location in the current loop.

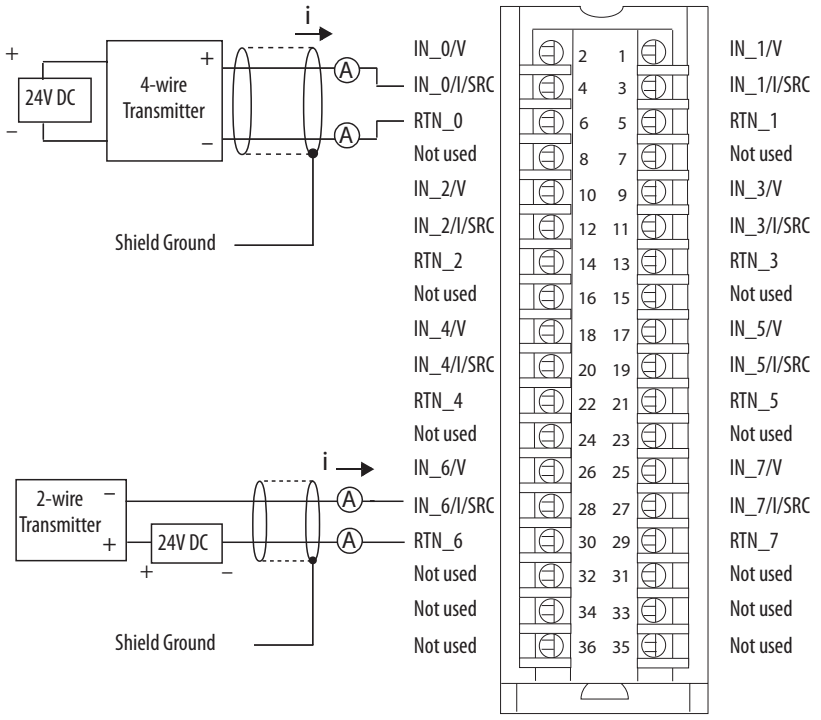


Figure 10 - 1756-IF8I Module Wiring Diagram -Current Mode with Internal Loop Power

IMPORTANT In this wiring diagram, the module provides 24V DC loop power.

IMPORTANT: Remember the following:

- If separate power sources are used, do not exceed the specific isolation voltage. For more information on module specifications, see the 1756 ControlLogix I/O Specifications Technical Data, publication 1756-TD002.
- Place additional loop devices, for example, strip chart recorders, at either 'A' location in the current loop.

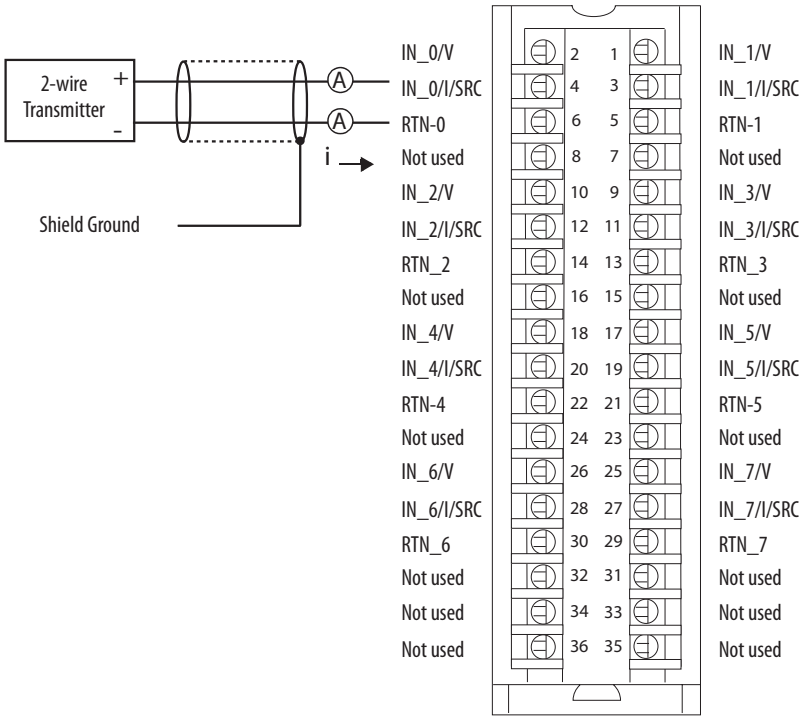
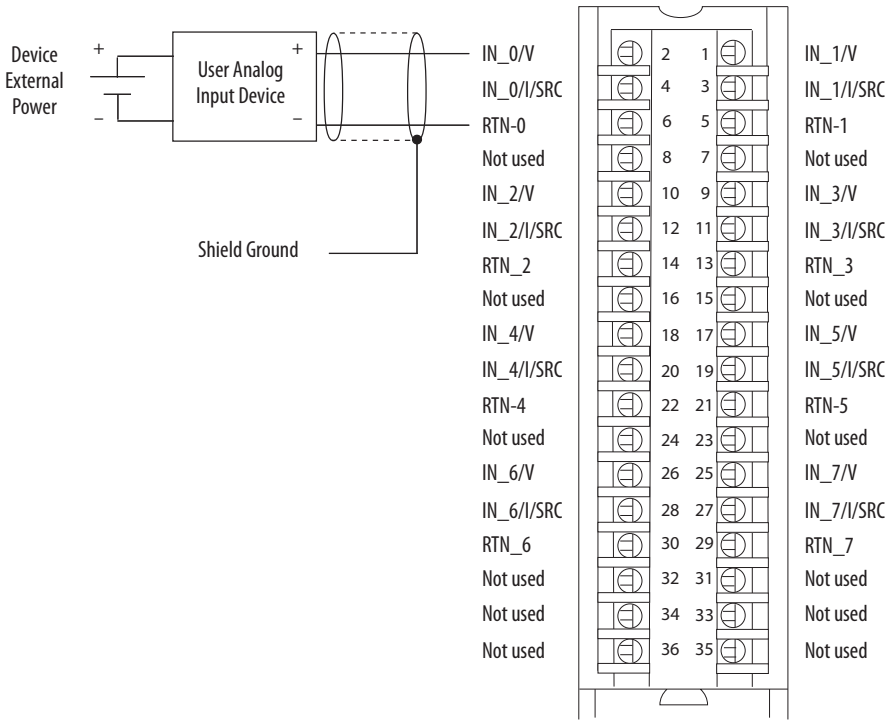


Figure 11 - 1756-IF8I Module Wiring Diagram - Voltage Mode

IMPORTANT: If separate power sources are used, do not exceed the specific isolation voltage. For more information on module specifications, see the 1756 ControlLogix I/O Specifications Technical Data, publication 1756-TD002.



Fault and Status Reporting

The 1756-IF8I module multicasts fault and status data with channel data to the owner and listening controllers. The data is returned via module tags that you can monitor in your Logix Designer application.

With some exceptions, as noted in the following table, the 1756-IF8I module provides the fault and data status in a channel-centric format.

The following table lists the 1756-IF8I module's fault and status tags available in the Logix Designer application.

Table 7 - 1756-IF8I Module - Fault and Status Data Tags

Data Type	Tag Name	Triggering Event That Sets Tag
Fault	Fault(1)	The owner-controller loses its connection to the module.
	Ch[x].Fault	The channel data quality is bad.
	Ch[x].Underrange	The channel data is beneath the absolute minimum for this channel.
	Ch[x].Overrange	The channel data is above the absolute maximum for this channel.
Status	CIPSyncValid(1)	Indicates whether the module has synchronized to a valid CIP Sync time master on the backplane.
	CIPSyncTimeout(1)	Indicates whether a valid time master on the backplane has timed out.
	CIPSyncOffsetJump(1)	Indicates a significant jump, that is, 1 ms or greater, in the CST and CIP Sync times sent from the Timemaster to the module. (The Timemaster sends the CST and CIP Sync times to the module every second.) When a significant jump occurs, this tag value becomes 1 but changes to 0 a second later unless another jump occurred.
	Ch[x].Uncertain	The channel data can be imperfect
	Ch[x].LLAlarm	The *I.Ch[x].Data* tag value is less than the *C.Ch[x].LLAlarmLimit* tag value, the *O.Ch[x].LLAlarmEn* tag is set and alarms are enabled for the channel.
	Ch[x].LAlarm	The *I.Ch[x].Data* tag value is less than the *C.Ch[x].LAlarmLimit* tag value, the *O.Ch[x].LAlarmEn* tag is set and alarms are enabled for the channel.
	Ch[x].HAlarm	The *I.Ch[x].Data* tag value is greater than the *C.Ch[x].HAlarmLimit* tag value, the *O.Ch[x].HAlarmEn* tag is set and alarms are enabled for the channel.
	Ch[x].HHAlarm	The *I.Ch[x].Data* tag value is greater than the *C.Ch[x].HHAlarmLimit* tag value, the *O.Ch[x].HHAlarmEn* tag is set and alarms are enabled for the channel.
	Ch[x].RateAlarm	The absolute change between consecutive channel samples exceeds the *C.Ch[x].RateAlarmLimit* tag value. This alarm only applies to enabled Process alarms.
	Ch[x].CalibrationFault	The last attempted Calibration for this channel failed.
	Ch[x].Calibrating	The channel is currently being calibrated
	Ch[x].CalGoodLowRef	A valid Low Reference signal has been sampled on this channel.
	Ch[x].CalBadLowRef	An invalid Low Reference signal has been sampled on this channel.
	Ch[x].CalGoodHighRef	An valid High Reference signal has been sampled on this channel.
	Ch[x].CalBadHighRef	An invalid High Reference signal has been sampled on this channel.
	Ch[x].CalSuccessful	Calibration on this channel is complete and the Calibrating state has been exited.
	Ch[x].RateOfChange	The change in channel data since last sample in Engineering Units/Second.
	Ch[x].Data	The channel data in scaled Engineering Units.
	Timestamp(1)	A 64-bit Timestamp indicating when all 8 channels were last sampled in terms of CIPSync time.
	RollingTimestamp(1)	16 bit timestamp that 'rolls' from 0…32,767 ms. Compatible with existing PID instruction to automatically calculate sample deltas.

(1) This tag provides module-wide data and affects all channels simultaneously.

1756-IRT8I Combined Temperature-sensing Isolated Analog Module

Topic	Page
1756-IRT8I Module Features	65
Module Block and Circuit Diagrams	87
Wire the 1756-IRT8I Module	89
Fault and Status Reporting	92

The 1756-IRT8I module has eight isolated channels. Each channel supports connection to the following input types:

- RTD, both 3-wire and 4-wire
- Thermocouple mV devices

The module provides 24-bit data resolution. Additional features are described in this chapter.

1756-IRT8I Module Features

The 1756-IRT8I module has the following features:

- Multiple Input Ranges
- Notch Filter
- Underrange/Overrange Detection
- Digital Filter
- Process Alarms
- Rate Alarm
- Sensor Offset
- 10 Ohm Copper Offset
- Wire Off Detection
- Temperature Units
- Sensor Types
- Thermocouple Wire Length Compensation
- Synchronized Sampling
- Cold Junction Compensation

IMPORTANT Most of the features available on the 1756-IRT8I module are software configurable. For more information on how to configure the module, see Chapter 7, Configure ControlLogix Isolated Analog I/O Modules on page 121

Multiple Input Ranges

The 1756-IRT8I module offers multiple input ranges. The input type and sensor type selections determine the available ranges.

The following table describes this module's input ranges in relation to the sensor type. If a single range is listed in the Input Range column, the programming application automatically selects the range used with the previously listed sensor type.

Table 8 - 1756-IRT8I Module - Channel Input Ranges

Input Type	Sensor Type	Input Range
RTD	Ohm	One of the following: • 1…500 Ω • 2…1000 Ω • 4…2000 Ω • 8…4000 Ω
	100 Ω PT 385	1…500 Ω
	200 Ω PT 385	2…1000 Ω
	500 Ω PT 385	4…2000 Ω
	1000 Ω PT 385	8…4000 Ω
	100 Ω PT 3916	1…500 Ω
	200 Ω PT 3916	2…1000 Ω
	500 Ω PT 3916	4…2000 Ω
	1000 Ω PT 3916	8…4000 Ω
	10 Ω CU 427	1…500 Ω
	120 Ω NI 672	1…500 Ω
	100 Ω NI 618	1…500 Ω
	120 Ω NI 618	1…500 Ω
	200 Ω NI 618	2…1000 Ω
	500 Ω NI 618	4…2000 Ω
Thermocouple	mV	-100…100 mV
	TC Type B	
	TC Type C	
	TC Type E	
	TC Type J	
	TC Type K	
	TC Type N	
	TC Type R	
	TC Type S	
	TC Type T	
	TC Type TXK/XK(L)	
	TC Type D	

To see where to select the input range, see page 127.

Notch Filter

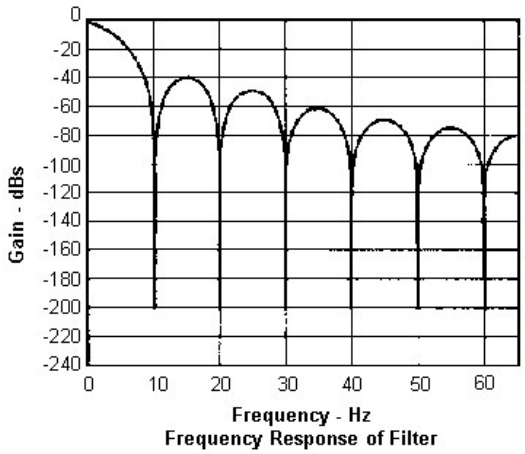
The notch filter is a built-in feature of the Analog-to-Digital convertor (ADC) that removes line noise in your application for **each channel**. The removal of line noise is also known as noise immunity.

The notch filter attenuates the input signal at the specified frequency. That is, the filter reduces the amplitude of the signal with minimal signal distortion.

Choose a notch filter based on what noise frequencies are present in the module's operating environment and any sampling requirements needed for control. The default Notch Filter setting is 60 Hz.

For example, a notch filter is typically set to 60 Hz to filter out 60 Hz AC line noise and its overtones. A 60 Hz notch filter setting attenuates frequencies of 60 Hz, 120 Hz, 180 Hz and so forth.

The following graphic shows 10 Hz notch filter selection and how the noise is dissipated over the entire spectrum but especially at the notch filter setting and its overtones.



Relationship between Noise Rejection Level and RPI Setting

The 1756-IRT8I module offers two levels of line noise rejection. Each level has a filter associated with it. The module automatically determines which filter is used based on the notch filter setting and RPI rate.

A trade-off exists between sampling speed and level of noise rejection:

- The faster the sampling speed, the less noise rejection. In this case, the module automatically uses a SINC^1 filter.

  The SINC^1 filter offers 34 dB noise rejection at the notch filter frequency and its overtones.

- The slower the sampling rate, the better noise rejection. In this case, the module automatically uses a SINC^3 filter.

  The SINC^3 filter offers 100 dB noise rejection at the notch filter frequency and its overtones.

The following table lists the available notch filter settings, the minimum RPI rate available with that notch filter setting, and the corresponding noise response.

Notch Setting	5 Hz	10 Hz	15 Hz	20 Hz	50 Hz	60 Hz (Default)	100 Hz	500 Hz	1000 Hz	5000 Hz
Minimum Sample Time (RPI) - SINC^1 Filter(1)	200.1 ms	100.1 ms	66.7 ms	50.1 ms	20.1 ms	16.7 ms	10.1 ms	2.1 ms	1.1 ms	1.0 ms
Minimum Sample Time (RPI) - SINC^3 Filter(1)	600.1 ms	300.1 ms	200.1 ms	150.1 ms	60.1 ms	50.1 ms	30.1 ms	6.1 ms	3.1 ms	1.0 ms
0…100% Step Response Time(2)(3)	600 ms + 1RPI	300 ms + 1RPI	200 ms + 1RPI	150 ms + 1RPI	60 ms + 1RPI	50 ms + 1RPI	30 ms + 1RPI	6 ms + 1 RPI	3 ms + 1RPI	1 ms + 1RPI
-3 dB Frequency(2)	1.3 Hz	2.7 Hz	4.3 Hz	5.1 Hz	13 Hz	15 Hz	26 Hz	128 Hz	258 Hz	1296 Hz
Typical Effective Resolution(2) (4)	19 bits	18 bits	18 bits	18 bits	17 bits	17 bits	17 bits	16 bits	15 bits	14 bits

(1) The minimum RPI value for the module depends on the channel with the lowest notch filter setting. For example, if three of the channels on a module use a Notch Filter setting of 20 Hz and one channel uses a Notch Filter setting of 60 Hz, you cannot set the module RPI lower than 50.1 ms.

(2) Using the SINC^3 filter.

(3) Worst case settling time to 100% of step change includes 0…100% step response time plus one RPI sample time.

(4) Measured in ±100 mV range.

For example, if your application requires a Notch Filter setting of 50 Hz, the module's minimum RPI rate is 20.1 ms. In this case, sampling speed is more important than noise rejection. The module automatically uses a SINC^1 filter.

If your application requires a Notch Filter setting of 50 Hz and the greater level of noise rejection provided by a SINC^3 filter, the minimum RPI rate is 60.1 ms. The module automatically uses a SINC^3 filter.

The RPI must be > 1/Notch Filter plus some small scan time for the ADC to sample properly. The SINC^3 filter takes 3 times as long and thus requires RPI > 3/Notch plus some small scan time. The module rejects combinations which violate that relationship.

The table below lists the available notch filter settings and the RPI values for the two types of filters.

Notch Filter	Fastest Available RPI	Fastest RPI for a SINC^3 Filter
5 Hz	200.1 ms	600.1 ms
10 Hz	100.1 ms	300.1 ms
15 Hz	66.7 ms	200.1 ms
20 Hz	50.1 ms	150.1 ms
50 Hz	20.1 ms	60.1 ms
60 Hz (default)	16.7 ms	50.1 ms
100 Hz	10.1 ms	30.1 ms
500 Hz	2.1 ms	6.1 ms
1000 Hz	1.1 ms	3.1 ms
5000 Hz	1.0 ms	1.0 ms

To see where to set the Notch Filter, see page 127.

Underrange/Overrange Detection

This feature detects when a temperature-measuring input module is operating beyond limits set by the input range. For example, if you are using the 1756-IRT8I module in the 2...1000 Ω input range and the module resistance increases to 1050 Ω, the overrange detection detects this condition.

The table lists the input ranges of non-isolated input modules and the lowest/highest signal available in each range before the module detects an underrange/overrange condition.

Table 9 - Low and High Signal Limits on Temperature-measuring Input Modules

Input Type	Available Range	Underrange Threshold	Overrange Threshold
RTD	1…500 Ω	≤ 0.00 Ω	510.00 Ω
	2…1000 Ω	≤ 0.00 Ω	1020.00 Ω
	4…2000 Ω	≤ 0.00 Ω	2040.00 Ω
	8…4000 Ω	≤ 0.00 Ω	4080.00 Ω
Thermocouple	-100…100 mV	- 101.00 mV	101.00 mV

IMPORTANT

Be aware that the Disable All Alarms feature, does not disable the underrange/overrange detection feature. The Disable All Alarms feature disables all alarms on the module.

The underrange/overrange detection feature is not an alarm. It is an indicator that channel data has gone beyond the absolute maximum or minimum, respectively, for the channel's chosen range but does not trigger an alarm.

To disable the underrange/overrange detection feature, you must disable the channel.

To see where to set the Underrange/Overrange detection values, see page 131.

Digital Filter

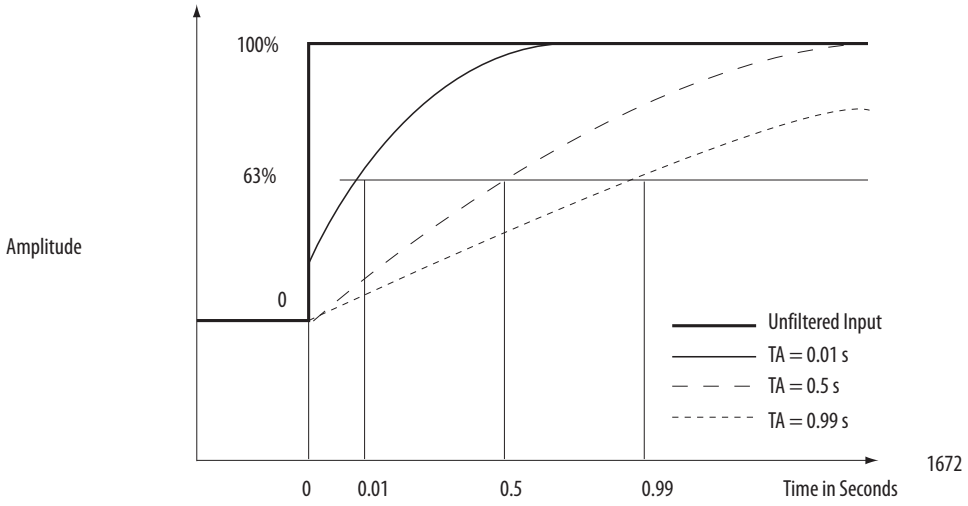
The digital filter smooths input data noise transients on each input channel. This value specifies the time constant for a digital first order lag filter on the input. It is specified in units of milliseconds. A value of 0 disables the filter.

The digital filter equation is a classic first order lag equation.

$$Y_n = Y_{n-1} + \frac{[\Delta t]}{\Delta t + TA} X_n - Y_{n-1}$$

Y_n = Present output, filtered peak voltage (PV)'
Y_{n-1} = Previous output, filtered PV
Δt = Module channel update time (seconds)
TA = Digital filter time constant (seconds)
X_n = Present input, unfiltered PV

By using a step input change to illustrate the filter response, you can see that when the digital filter time constant elapses, 63.2% of the total response is reached. Each additional time constant achieves 63.2% of the remaining response.



To see where to set the Digital Filter, see page 127.

Process Alarms

Process alarms alert you when the module has exceeded configured high or low limits for **each channel**. These are set at four, user-configurable, alarm trigger points:

- High high
- High
- Low
- Low low

You can enable or disable Process Alarms individually via the Output tags for each channel. When a module is added to your Logix Designer application project and tags are created, the Alarms are disabled by default.

Each individual Process Alarm enable tag, that is, *O.Ch[x].LLAlarmEn, O.Ch[x].LAlarmEn, O.Ch[x].HAlarmEn and O.Ch[x].HHAlarmEn*, is disabled when the module is created. You must enable the tags in the Output Data to allow the individual alarm to trigger.

If a Process Alarm's enable bit is not set, the corresponding Input Process Alarm never triggers. To see where to set the Process Alarms, see page 131.

You can latch process alarms. The alarm remains on, even if the condition causing it to occur disappears, until the alarm is unlatched.

IMPORTANT You must manually unlatch the alarm. You can unlatch the alarm, by using one of the following methods:

- While the project is online, click the Alarm Configuration tab on the Module. Then click Unlatch to unlatch a specific alarm or Unlatch All to unlatch all alarms.
- Change the module output tag for the alarm that you want to unlatch. For example, the *Ch[x].LLAlarmUnlatch* tag to unlatch a Low Low Alarm.

  For more information on module tags, see Appendix A, Isolated Analog I/O Module Tag Definitions on page 173.

- Use a CIP Generic message.

  For more information how to use a CIP Generic message, see Rockwell Automation Knowledgebase article #63046, How to Reset Latched Status of an Analog Module. You can access the article at:

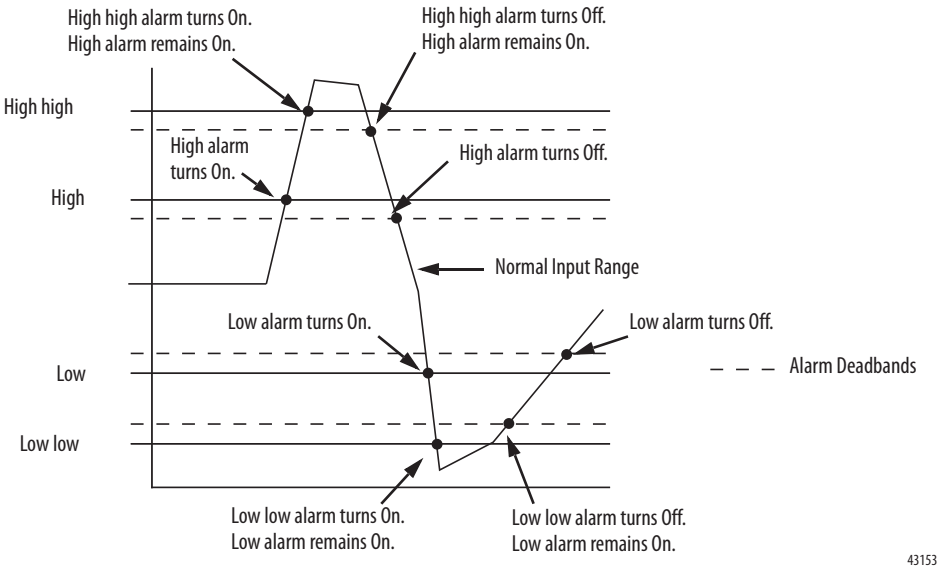
  https://rockwellautomation.custhelp.com/

Alarm Deadband

You can configure an alarm deadband to work with these alarms. The deadband lets the process alarm status bit remain set, despite the alarm condition disappearing, as long as the input data remains within the deadband of the process alarm.

The following graphic shows input data that sets each of the four alarms at some point during module operation. In this example, latching is disabled; therefore, each alarm turns Off when the condition that caused it to set ceases to exist.

Figure 12 - Alarm Deadband Alarm Settings



To see where to set the Alarm Deadband, see page 131.

Rate Alarm

The rate alarm triggers if the rate of change between input samples for **each channel** exceeds the specified trigger point for that channel. The actual rate of change for the last sample is returned in the *Ch[x].RateOfChange* input tag of each channel.

EXAMPLE

In normal scaling in Celsius, if you configure a channel's rate alarm to 100.1 °C/s, the rate alarm triggers only if the difference between measured input samples changes at a rate > 100.1 °C/s.

Consider the following conditions:

- The module's RPI is 100 ms, that is, new data is sampled every 100 ms.
- At **input sample #1**, the channel measures 355 °C.
- At **input sample #2**, (100 ms later) the channel measures 363 °C.

  At this sample instance, the **rate alarm is not triggered** because the rate of change is less than 100.1 °C/s.

  The rate of change is 80 °C/s [(363 °C- 355 °C) / (100 ms)].
- At **input sample #3** (100 ms later) the channel measures 350.3 °C.

  At this sample instance, the **rate alarm is triggered** because the rate of change is greater than 100.1 °C.

  The rate of change is 127 °C. [(350.3 °C - 363 °C) / (100 ms)].

  At this sample instance, the absolute value of this result is > 100.1 °C, so the rate alarm sets. Absolute value is used because rate alarm checks for the magnitude of the rate of change being beyond the trigger point, whether a positive or negative excursion.

To see where to set the Rate Alarm, see page 131.

Sensor Offset

The sensor offset value compensates for any known error on the sensor or channel to which the sensor is connected. The value is set in signal units.

You set this value via a module output tags. That is, tag *O.Ch[x].SensorOffset*. Where x represents the module channel.

10 Ohm Copper Offset

With this feature, you can compensate for a small offset error in a 10 ohm copper RTD. The channel must be connected to the 10 Ohm CU 427 Sensor Type to use this feature. The offset value is indicated in units of 0.01 Ohms.

You can set the 10 Ohm copper offset in either of the following ways:

- On the Configuration tab of the Module Properties dialog box. In this case, valid values are from -0.99...0.99.
- Directly in the channel's *C.Ch[x].TenOhmOffset* tag. In this case, valid values are -99...99

For example, if the resistance of a copper RTD used with a channel is 9.74 Ω at 25 °C, you account for error by setting the 10 Ohm Copper Offset field on the Configuration tab to -0.26 or by setting the *C.Ch[x].TenOhmOffset* to -26.

To see where to set the 10 Ohm Copper Offset on the Configuration tab, see page 127.

Wire Off Detection

The 1756-IRT8I module alerts you when one or more wires have been disconnected from a channel.

When a wire off condition occurs, the following events occur:

- Input data for the channel changes to a specific scaled value.
- A fault bit is set in the owner-controller indicating the presence of a wire off condition.

For more information on module behavior when a wire off condition occurs, see Table 10 on page 76.

IMPORTANT	Be aware that the Disable All Alarms feature, does not disable the wire off detection feature. The Disable All Alarms feature disables all alarms on the module. The wire off detection feature is not an alarm. It is an indicator that a wire has been disconnected from the channel but does not trigger an alarm. To disable the wire off detection feature, you must disable the channel.

Because these modules can each be used in various applications, differences exist when a wire off condition is detected in each application. The table lists the differences that occur when a wire off condition occurs in various applications.

Table 10 - 1756-IRT8I Module - Wire Off Conditions

Application Configuration	Wire Off Condition Cause	Resulting Module Behavior
Input Type = RTD Sensor Type = Temperature or Ohm	When using a **3-wire RTD** device and any of the following exists: • One wire is disconnected from any of the channel's terminals. • Wires are disconnected from any combination of terminals: – IN_*x*(+)/A – IN_*x*(-)/B – IN_*x*/RTD C • All of the wires are disconnected from the channel. With the 3-wire RTD device, the wire off condition is **detected within two seconds** of wires getting disconnected.	The following occurs: • Input data for the channel changes to the highest scaled temperature value associated with the selected sensor type. • The *I.Ch[x].Overrange* tag is set to 1. *x* represents the channel number.
	When using a **4-wire RTD** device and any of the following exists: • A wire is disconnected from only terminal IN_*x*(-)/B. • Wires are disconnected from any combination of the channel's terminals, that is: – IN_*x*(+)/A – IN_*x*(-)/B – IN_*x*/RTD C – IN_*x*/RTD D **IMPORTANT**: There is one combination exception that does not apply. A wire off condition is not detected when wires are simultaneously disconnected from only IN_*x*/RTD C and IN_*x*/RTD D terminals. • All wires are disconnected from the module. With the 4-wire RTD device, the wire off condition is **detected within five seconds** of wires getting disconnected.	If bullet 1, the following occurs: • Input data for the channel changes to the lowest scaled temperature value associated with the selected sensor type. • The *I.Ch[x].Underrange* tag is set to 1. *x* represents the channel number. If bullets 2 or 3, the following occurs: • Input data for the channel changes to the highest scaled temperature value associated with the selected sensor type. • The *I.Ch[x].Overrange* tag is set to 1. *x* represents the channel number.
Input Type = Thermocouple Sensor Type = Temperature	A wire is disconnected from the module. With the Thermocouple input type, the wire off condition is **detected within two seconds** of wires getting disconnected.	• Input data for the channel changes to the highest scaled temperature value associated with the selected sensor type. • The *I.Ch[x].Overrange* tag is set to 1. *x* represents the channel number.
Input Type = Thermocouple Sensor Type = mV		• Input data for the channel changes to the scaled value associated with the overrange signal value. • The *I.Ch[x].Overrange* tag is set to 1. *x* represents the channel number.

Temperature Units

You can use the following temperature units with your 1756-IRT8I module:

- Celsius
- Kelvin
- Fahrenheit
- Rankine

Each channel is individually configurable for its temperature units.

To see where to set the Temperature Units, see page 127.

Sensor Types

This module supports multiple sensor types with the available selections dictated by the input type configuration.

Table 11 - Available Sensor Types on 1756-IRT8I Module

Input Type	Available Sensor Types
RTD	100 Ω PT 385 200 Ω PT 385 500 Ω PT 385 1000 Ω PT 385 100 Ω PT 3916 200 Ω PT 3916 500 Ω PT 3916 1000 Ω PT 3916 10 Ω CU 427 120 Ω NI 672 100 Ω NI 618 120 Ω NI 618 200 Ω NI 618 500 Ω NI 618
Thermocouple	B, C, D, E, J, K, N, R, S, T, TXK/XK (L)

To see where to set the Sensor Type, see page 127.

Sensor Type Temperature Limits

Sensor type temperature limits are determined by your choice of Input Type, Sensor Type, and Temperature Units.

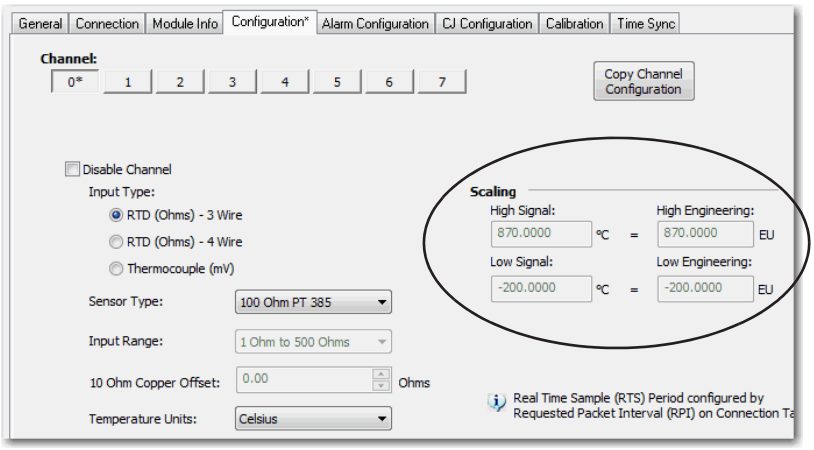
IMPORTANT	When you make the configuration choices listed previously, the **Scaling parameters are automatically set** on the Configuration tab of the Module Properties dialog box and **cannot be changed** in the software. The Low Signal value equals the Low Engineering value. The High Signal value equals the High Engineering value.

For example, you can configure a channel with the following parameters:

- Input Type = RTD (Ohms)
- Sensor Type = 100 Ohm PT 385
- Temperature Units = Celsius

In this case, the Scaling parameters are set as follows:

- Low Signal = -200.0000 °C
  Low Engineering = -200.0000
- High Signal = 870.0000 °C
  High Engineering = 870.0000



The following table lists temperature range limits on the 1756-IRT8I module.

Table 12 - Temperature Limits for RTD and Thermocouple Sensor Types

Input Type	Sensor Type	Temperature Range Limits
RTD (Ohms) - 3-wire or 4-wire	100 Ohm PT 385 200 Ohm PT 385 500 Ohm PT 385 1000 Ohm PT 385	-200…870 °C -328…1598 °F 73…1143 °K 132…2058 °R
	100 Ohm PT 3916 20 Ohm PT 3916 500 Ohm PT 3916 1000 Ohm PT 3916	-200…630 °C -328…1166 °F 73…903 °K 132…1626 °R
	10 Ohm CU 247	-200…260 °C -328…500 °F 73…533 °K 132…960 °R
	120 Ohm NI 672	-80…320 °C -112…608 °F 193…593 °K 348…1068 °R
	100 Ohm NI 618 120 Ohm NI 618 200 Ohm NI 618 500 Ohm NI 618	-60…250 °C -76…482 °F 213…523 °K 384…942 °R

Table 12 - Temperature Limits for RTD and Thermocouple Sensor Types

Input Type	Sensor Type	Temperature Range Limits
Thermocouple (mV)	TC Type B	21…1820 °C 68…3308 °F 293…2093 °K 528…3768 °R
	TC Type C	0…2320 °C 32…4208 °F 273…2593 °K 492…4668 °R
	TC Type D	0…2320 °C 32…4208 °F 273…2593 °K 492…4668 °R
	TC Type E	-270…1000 °C -454…1832 °F 3…1273 °K 6…2292 °R
	TC Type J	-210…1200 °C -346…2192 °F 63…1473 °K 114…2652 °R
	TC Type K	-270…1372 °C -454…2502 °F 3…1645 °K 6…2961 °R
	TC Type N	-270…1300 °C -454…2372 °F 3…1573 °K 6…2832 °R
	TC Type R	-50…1768 °C -58…3215 °F 223…2041 °K 402…3674 °R
	TC Type S	-50…1768 °C -58…3215 °F 223…2041 °K 402…3674 °R
	TC Type T	-270…400 °C -454…752 °F 3…673 °K 6…1212 °R
	TC Type TXK/XK (L)	-200…800 °C -328…1472 °F 73…1073 °K 132…1932 °R

Thermocouple Wire Length Compensation

Wires connecting a thermocouple to the 1756-IRT8I module have an intrinsic resistance that can negatively impact the module's accuracy. The wire length and gauge are directly related to resistance level and, by extension, to impact on the module accuracy. The longer the wire length, the greater the resistance, the greater the possible negative impact on module accuracy.

To avoid increased module error resulting from increased resistance levels, the 1756-IRT8I module can automatically compensate for resistance levels and maintain its accuracy. The module measures the wire resistance and actively compensates for that resistance with each sample.

IMPORTANT This functionality works when thermocouple wiring is connected to the module before the module is powered or power is cycled to the module.

Connect wiring to the module before applying or cycling module power.

You can disable compensation by removing the wiring prior to a power cycle and reconnecting the wiring later.

Synchronized Sampling

This feature lets you synchronize input sampling across inputs on multiple modules in the same chassis, forcing those inputs to sample simultaneously within approximately 20 μS of each other.

IMPORTANT Synchronized Sampling is not limited to input sample across inputs on the same module types.

You can use Synchronized Sampling across inputs on 1756-IF8I modules and 1756-IRT8I modules in the same system.

For example, if you have 12 input devices connected to two 1756-IRT8I modules and one 1756-IF8I module in the same chassis, or different chassis synchronized to the same CIP Sync TimeMaster, use Synchronized Sampling to take a snapshot of the input data available at each input at a single moment in time.

The following conditions must exist to use this feature:

- A 1588 CIP Sync Time Master is configured for the chassis.
- All modules in the set use the same RPI value or values that are multiples of each other.
- Synchronized Sampling with Other Synchronized Modules is enabled for all input channels in the set.

  For these input modules, configuring one channel for Synchronized Sampling synchronizes all eight channels.

While setting the RPI to the same value on all 1756-IRT8I modules guarantees that each module samples at the same rate, it does not guarantee that they sample at the same time.

When enabled, Synchronized Sampling provides each module a synchronized starting point for its respective input scans. Because the RPI values are the same, the inputs on the modules are sampled at the same rate and the same time.

To see where to enable Synchronized Sampling, see page 127.

Cold Junction Compensation

When using the 1756-IRT8I module with a thermocouple input type, the channel must account for the thermoelectric effect of a junction of the thermocouple field wires and the screw terminals of an RTB or IFM.

The junction at which temperature is measured is the hot junction. The junction where the thermocouple wire interfaces with copper is the cold junction. The transition from thermocouple wire to copper typically happens either on the module screw terminal itself or at an IFM.

The thermoelectric effect alters the input signal and must be compensated for to measure temperatures accurately. To accurately compensate the input signal from your module, you must use a cold junction compensation (CJC) sensor to account for the increased voltage.

IMPORTANT	CJC sensors are only required with use of the Thermocouple input type and when channel wiring is connected via an RTB. If you are using an IFM to connecting wiring to a channel using the Thermocouple input type, you do not need to use CJC sensors. CJC sensors **do not** come with the 1756-IRT8I module. You must order CJC sensors, product catalog number 1756-CJC, separately from the 1756-IRT8I module for CJC sensors which attach directly to the module's screw terminals. Catalog number 1756-CJC includes two CJC sensors. To order CJC sensors, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Remember the following when compensating the input signal from your module:

- Cold junction compensation is optional and can be disabled.
- The 1756-IRT8I module uses two channels for cold junction compensation. When using an RTB, you must connected CJC sensors at RTB terminals 1 and 2 and 35 and 36.

IMPORTANT	If you use cold junction compensation, you must connect CJC sensors to both channels, that is, terminals 1, 2, 35, and 36. You cannot use cold junction compensation and connect a CJC sensor to only one channel.

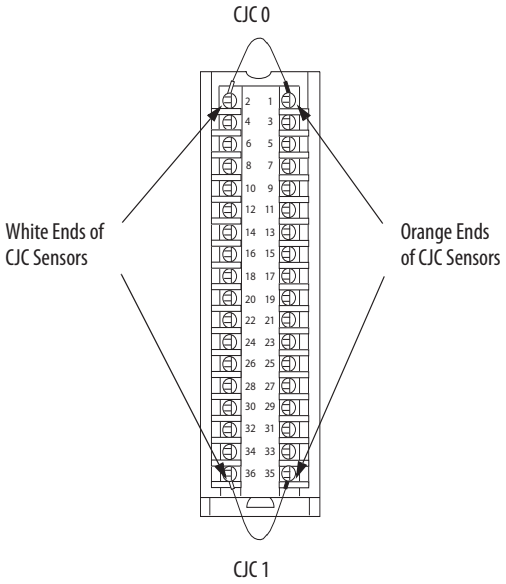
- Differences exist between using an RTB or IFM to connect wiring to the module. They are described in the rest of this section.

Connecting a CJC via a Removable Terminal Block

When using an RTB, if you choose to connect CJC sensors to your module, you must connect a CJC sensor at the top of the RTB and one at the bottom of the RTB.

IMPORTANT Remember the following:

- Connect the white end of the CJC sensor to the even-numbered terminals. For CJ 0, connect the white end to terminal 2. For CJ 1, connect the white end to terminal 36.
- Connect the orange end of the CJC sensor to the odd-numbered terminals. For CJ 0, connect the orange end to terminal 1. For CJ 1, connect the orange end to terminal 35.
- Two CJC values indicate the temperature of the top and bottom CJC sensor
- CJC sensor temperatures are indicated in degrees Celsius.

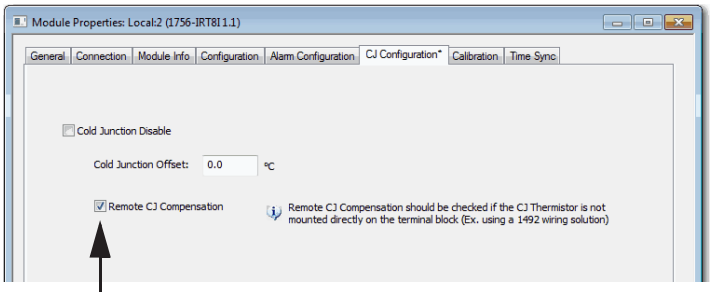


Connecting a Cold Junction Sensor via an Interface Module

The IFMs use an isothermal bar to maintain a steady temperature at all module terminations. When using the IFM, we recommend that you mount it so that the black anodized aluminum bar is in the horizontal position.

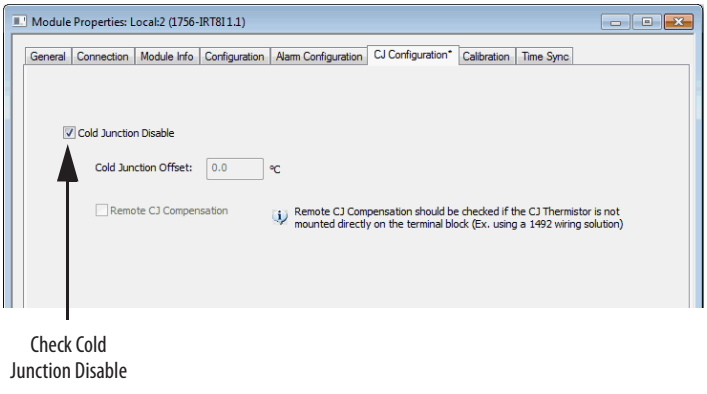
When using an IFM, do not connect a CJC sensor to the module because it is built into the IFM. However, you must enable the Remote CJ Compensation field in the Logix Designer application as shown below.

If you connect a CJS via an IFM, configure the module as shown on the Module Properties Configuration tab.



Cold Junction Disable Option

You can disable cold junction compensation on your 1756-IRT8I module. Check Cold Junction Disable to disable compensation as shown below.

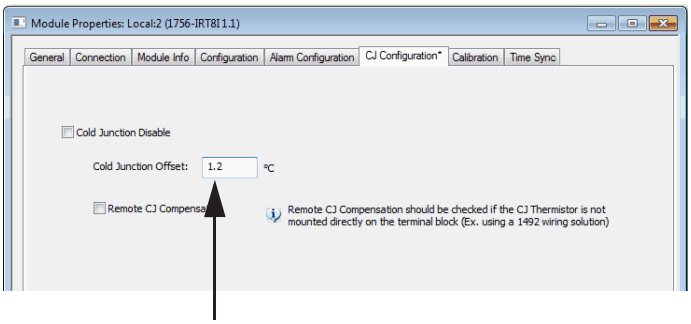


IMPORTANT Consider the following before disabling cold junction compensation:

- We recommend that you do not disable the cold junction disable option.
  Typically, this option is used only in systems that have no thermoelectric effect, such as test equipment in a controlled lab.
- The Cold Junction Disable box on the Module Properties Configuration tab disables cold junction compensation on all module channels.

Cold Junction Offset Option

The Cold Junction Offset box on the Module Properties Configuration Tab lets you make module-wide adjustments to cold junction compensation values. If you know that your cold junction compensation values are consistently inaccurate by some level, for example, 1.2 °C, type the value into the box to account for this inaccuracy.



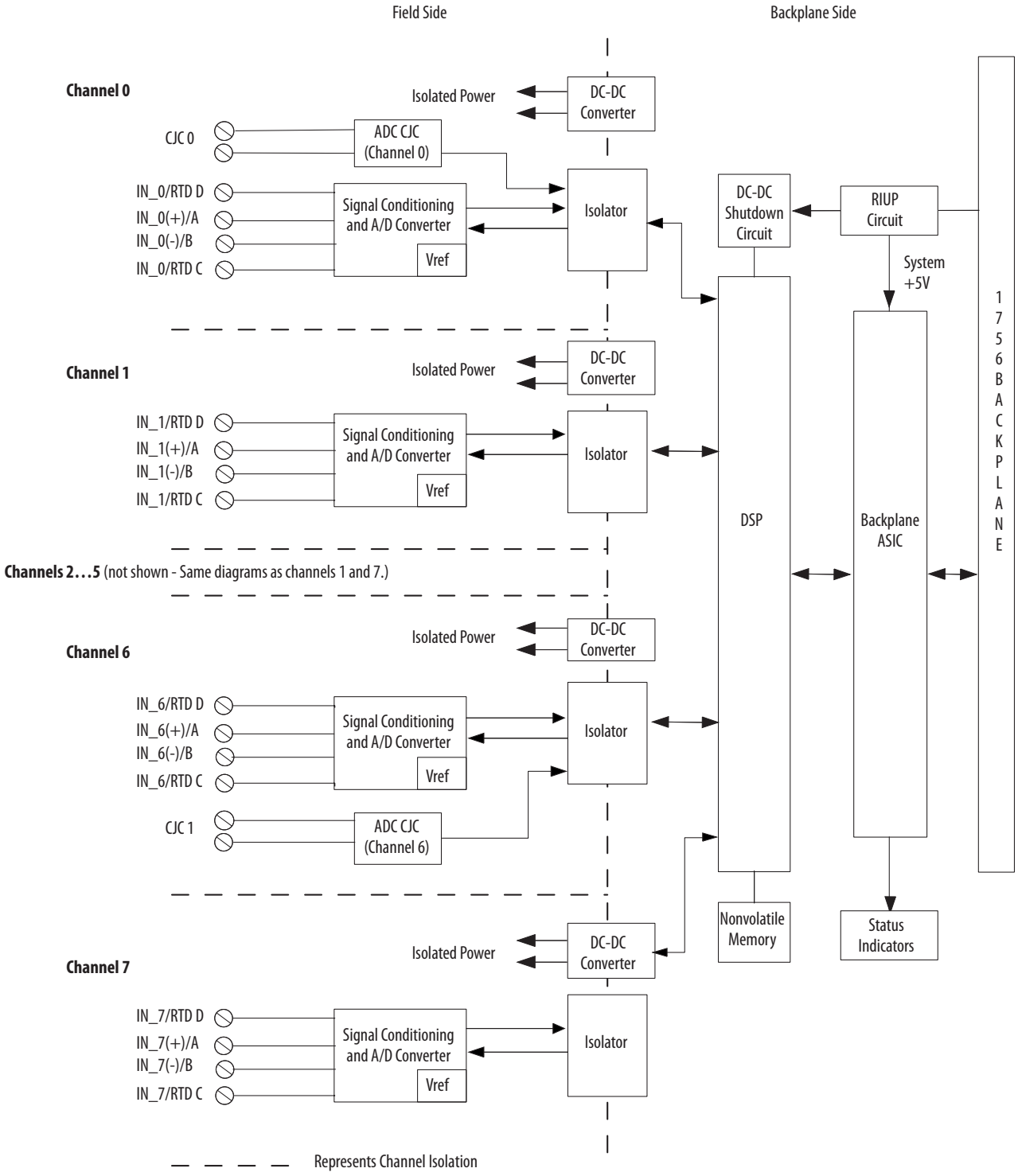
Type offset value.

IMPORTANT Cold Junction temperatures are always reported as Celsius temperature units, and, offset values are always set in Celsius temperature units.
You cannot change the temperature units.

Module Block and Circuit Diagrams

The graphics in this section show the 1756-IRT8I module's block diagrams and field-side circuit diagrams.

Figure 13 - 1756-IRT8I Module Block Diagram



Field-side Circuit Diagrams

The following diagrams show the field-side circuitry for the 1756-IRT8I module.

Figure 14 - 1756-IRT8I Module Field-side with 3-wire RTD Input

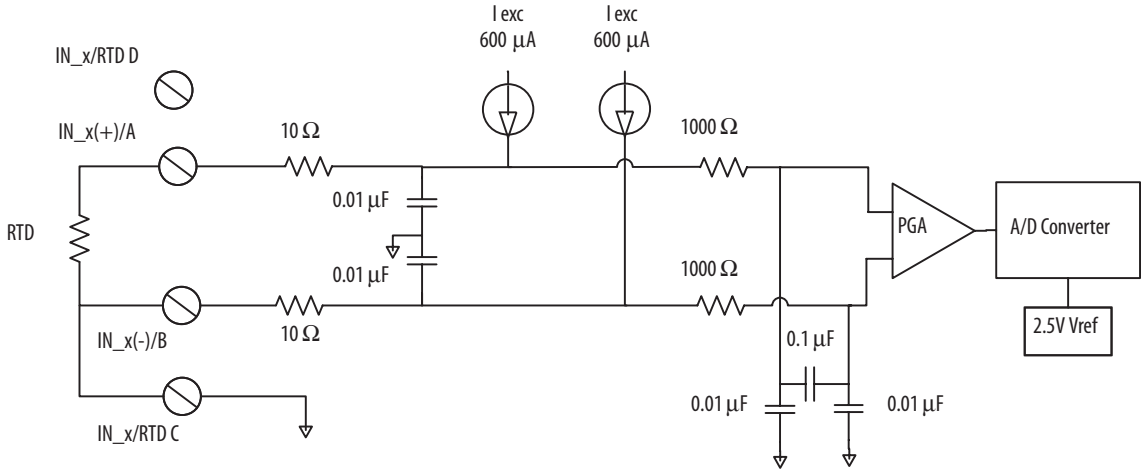


Figure 15 - 1756-IRT8I Module Field-side with 4-wire RTD Input

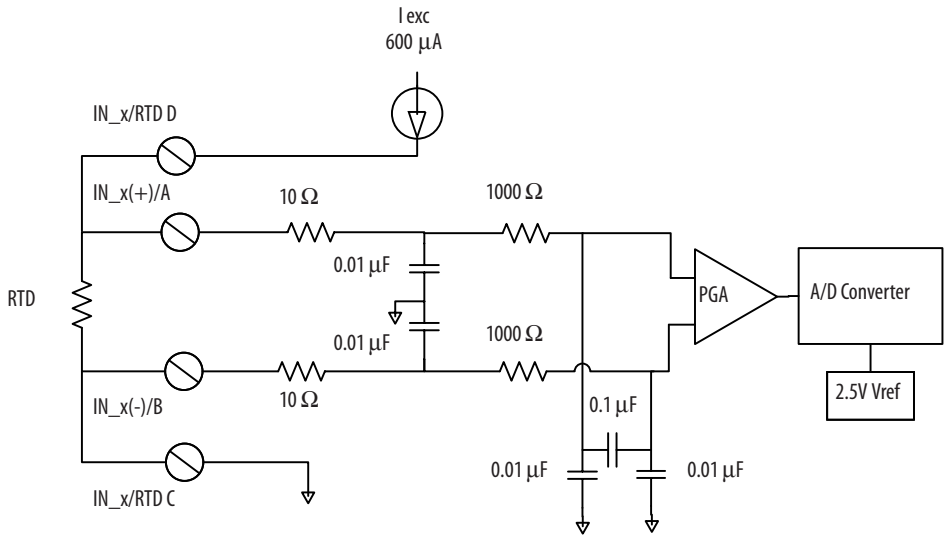
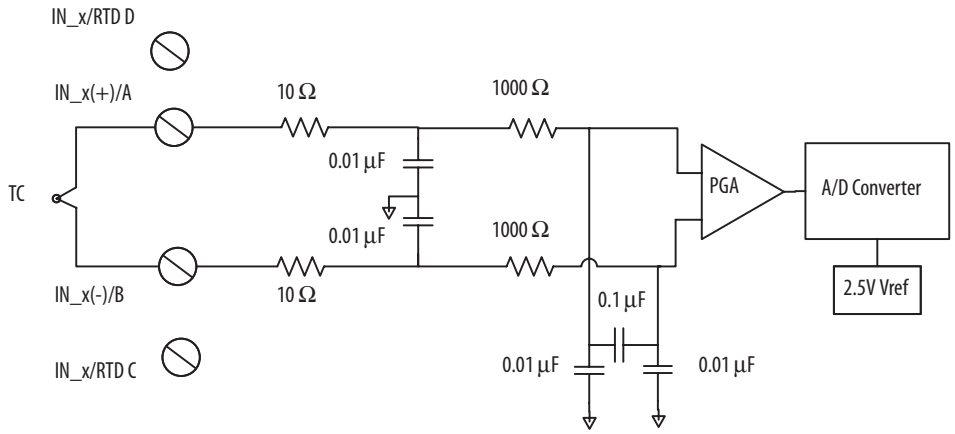


Figure 16 - 1756-IRT8I Module Field-side Circuit with Thermocouple Input



Wire the 1756-IRT8I Module

The following graphics show wiring examples for the 1756-IRT8I module used with RTD and thermocouple input types.

Figure 17 - 1756-IRT8I Module Wiring Diagram - 3-wire RTD Input

MPORTANT: Remember the following:

- If separate power sources are used, do not exceed the specific isolation voltage. For more information on module specifications, see the 1756 ControlLogix I/O Specifications Technical Data, publication 1756-TD002.
- Terminals 1, 2, 35, and 36 are not used in RTD applications.
- For 2-wire resistor applications including calibration, make sure IN_x(-)/B and IN_x/RTD C are shorted together.

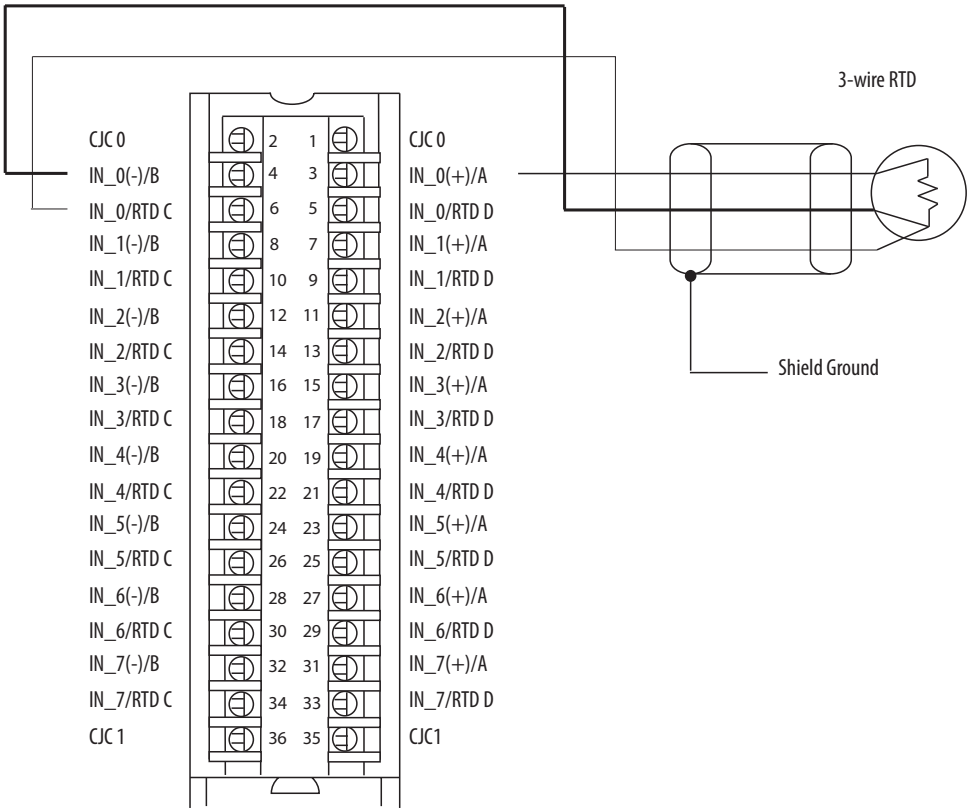


Figure 18 - 1756-IRT8I Module Wiring Diagram - 4-wire RTD Input

IMPORTANT: Remember the following:

- If separate power sources are used, do not exceed the specific isolation voltage. For more information on module specifications, see the 1756 ControlLogix I/O Specifications Technical Data, publication 1756-TD002.
- Terminals 1, 2, 35, and 36 are not used in RTD applications.

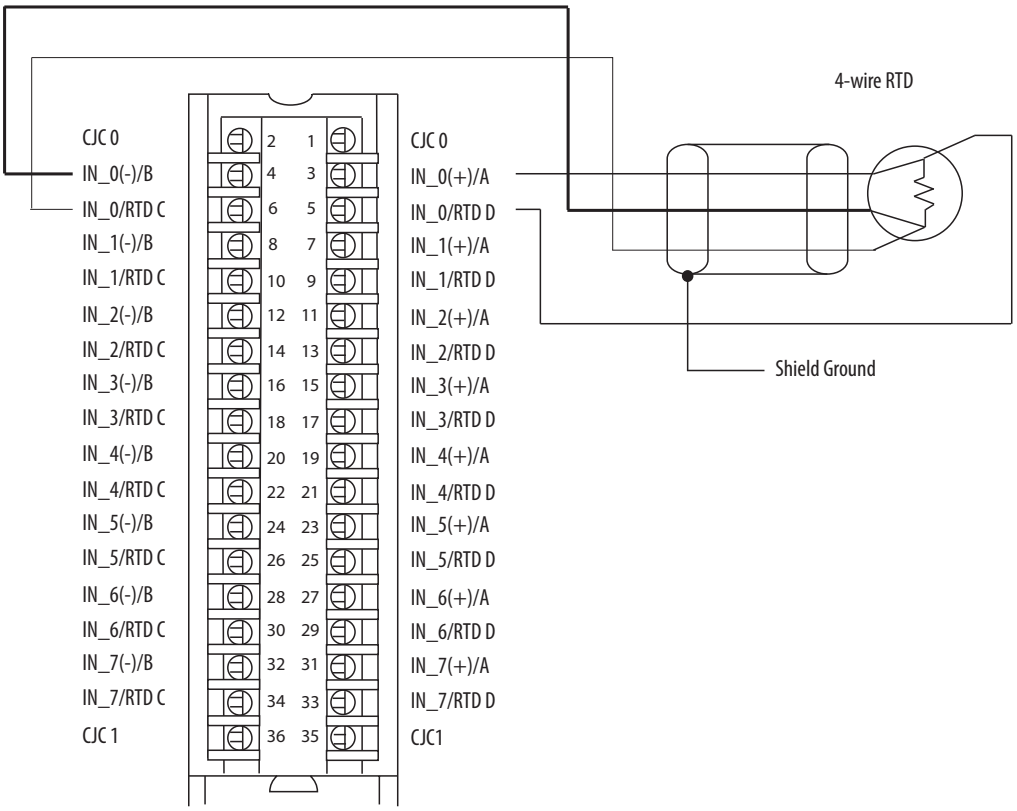
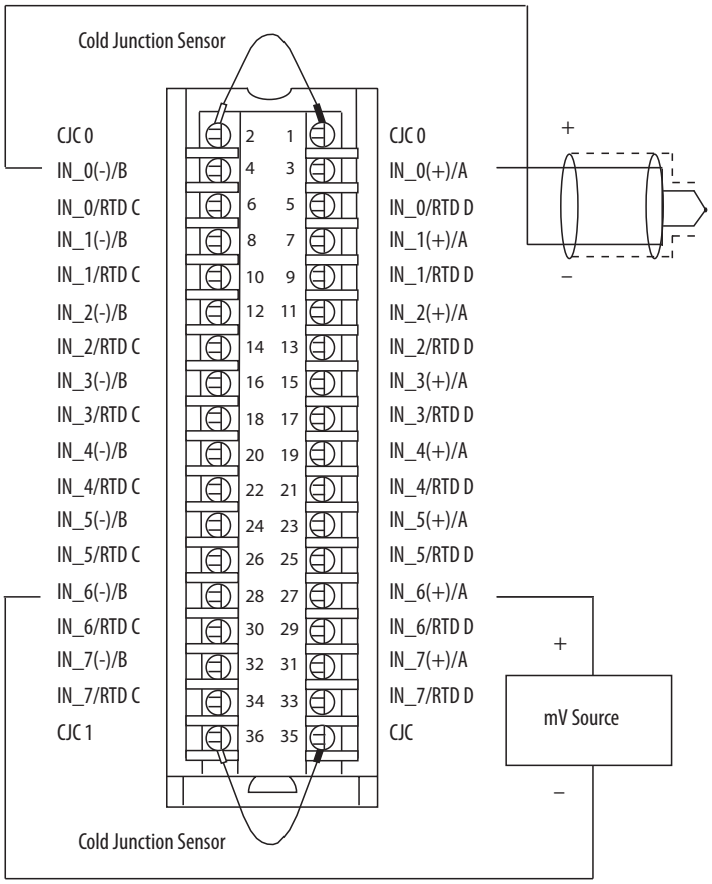


Figure 19 - 1756-IRT8I Module Wiring Diagram - Thermocouple Input

IMPORTANT: Remember the following:

- Connect the white end of the CJC sensor to the even-numbered terminal., and connect the orange end of the CJC sensor to the odd-numbered terminals.
  For CJC 0:
  - White end - Connected to terminal number 2
  - Orange end - Connected to terminal number 1

  For CJC 1:
  - White end - Connected to terminal number 36
  - Orange end - Connected to terminal number 35
- If separate power sources are used, do not exceed the specific isolation voltage. For more information on module specifications, see the 1756 ControlLogix I/O Specifications Technical Data, publication 1756-TD002.



Fault and Status Reporting

The 1756-IRT8I module multicasts fault and status data with channel data to the owner and listening controllers. The data is returned via module tags that you can monitor in your Logix Designer application.

With some exceptions, as noted in the following table, the 1756-IRT8I module provides the fault and data status in a channel-centric format.

The following table lists the 1756-IRT8I module's fault and status tags available in the Logix Designer application.

Table 13 - 1756-IRT8I Module - Fault and Status Data Tags

Data Type	Tag Name	Triggering Event That Sets Tag
Fault	Fault(1)	The owner-controller loses its connection to the module.
	CJ[x].Underrange	The cold junction for the channel is below 0 °C
	CJ[x].Overrange	The cold junction for the channel is above 86 °C
	Ch[x].Fault	The channel data quality is bad.
	Ch[x].Underrange	The channel data is beneath the absolute minimum for this channel.
	Ch[x].Overrange	The channel data is above the absolute maximum for this channel.
Status	CIPSyncValid(1)	Indicates whether the module has synchronized to a valid CIP Sync time master on the backplane.
	CIPSyncTimeout(1)	Indicates whether a valid time master on the backplane has timed out.
	CIPSyncOffsetJump(1)	Indicates a significant jump, that is, 1 ms or greater, in the CST and CIP Sync times sent from the Timemaster to the module. (The Timemaster sends the CST and CIP Sync times to the module every second.) When a significant jump occurs, this tag value becomes 1 but changes to 0 a second later unless another jump occurred.
	Ch[x].Uncertain	The channel data can be imperfect.
	Ch[x].LLAlarm	The *I.Ch[x].Data* tag value is less than the *C.Ch[x].LLAlarmLimit* tag value, the *O.Ch[x].LLAlarmEn* tag is set and alarms are enabled for the channel.
	Ch[x].LAlarm	The *I.Ch[x].Data* tag value is less than the *C.Ch[x].LAlarmLimit* tag value, the *O.Ch[x].LAlarmEn* tag is set and alarms are enabled for the channel.
	Ch[x].HAlarm	The *I.Ch[x].Data* tag value is greater than the *C.Ch[x].HAlarmLimit* tag value, the *O.Ch[x].HAlarmEn* tag is set and alarms are enabled for the channel.
	Ch[x].HHAlarm	The *I.Ch[x].Data* tag value is greater than the *C.Ch[x].HHAlarmLimit* tag value, the *O.Ch[x].HHAlarmEn* tag is set and alarms are enabled for the channel.
	Ch[x].RateAlarm	The absolute change between consecutive channel samples exceeds the *C.Ch[x].RateAlarmLimit* tag value. This alarm only applies to enabled Process alarms.
	Ch[x].CalibrationFault	The last attempted Calibration for this channel failed.
	Ch[x].Calibrating	The channel is currently being calibrated.
	Ch[x].CalGoodLowRef	A valid Low Reference signal has been sampled on this channel.
	Ch[x].CalBadLowRef	An invalid Low Reference signal has been sampled on this channel.
	Ch[x].CalGoodHighRef	An valid High Reference signal has been sampled on this channel.
	Ch[x].CalBadHighRef	An invalid High Reference signal has been sampled on this channel.
	Ch[x].CalSuccessful	Calibration on this channel is complete and the Calibrating state has been exited.
	Ch[x].RateOfChange	The change in channel data since last sample in Engineering Units/Second.
	Ch[x].Data	The channel data in scaled Engineering Units.
	Timestamp(1)	A 64-bit Timestamp indicating when all 8 channels were last sampled in terms of CIPSync time.
	RollingTimestamp(1)	16 bit timestamp that 'rolls' from 0…32,767 ms. Compatible with existing PID instruction to automatically calculate sample deltas.

(1) This tag provides module-wide data and affects all channels simultaneously.

1756-OF8I Isolated Analog Output Module

Topic	Page
1756-OF8I Module Features	98
Module Block and Output Circuit Diagrams	98
Drive Different Loads with the 1756-OF8I Module	100
Wire the 1756-OF8I Module	100
Fault and Status Reporting	102

The 1756-OF8I module has eight isolated channels. Each channel supports the following output types:

- Current
- Voltage

The module provides 16-bit resolution. Additional features are described in this chapter.

1756-OF8I Module Features

The 1756-OF8I module has the following features:

- Multiple Output Ranges
- Channel Offset
- Ramping/Rate Limiting
- Hold for Initialization
- Clamping/Limiting
- Clamp/Limit Alarms
- Data Echo

IMPORTANT Most of the features available on the 1756-OF8I module are software configurable. For more information on how to configure the module, see Chapter 7, Configure ControlLogix Isolated Analog I/O Modules on page 121.

Multiple Output Ranges

The 1756-OF8I module offers multiple output ranges that are dictated by channel configuration choices. The output type selection determines the available ranges.

Table 14 - Channel Output Ranges

Output Type	Output Range
Current (mA)	0…20 mA
Voltage (V)	Any of the following: • -10…10V • 0…5V • 0…10V

To see where to select the output range, see page 127.

Channel Offset

With this feature, you can compensate for any known error on the sensor or channel to which the sensor is connected. This value is in signal units and is added to the output data.

You can set the channel offset in either of the following ways:

- On the Configuration tab of the Module Properties dialog box.
- Directly in the channel's *C.Ch[x].Offset* tag.

For example, if the channel has an error such that it reads 8 mA as 7.8 mA, you account for the error by setting the Channel Offset field on the Configuration tab to 0.2000 or by setting the *C.Ch[x].Offset* tag to 0.2.

To see where to set the Channel Offset, see page 127.

Ramping/Rate Limiting

Ramping limits the speed at which an analog output signal can change. This prevents fast transitions in the output from damaging the devices that an output module controls. Ramping is also known as rate limiting.

The table describes the types of ramping that are possible.

Ramping type	Description
Run mode ramping	When the module is in Run mode, ramping occurs to all new output values at the MaxRampRate.
Ramp to Program mode	When the present output value changes to the Program value after a Program command is received from the controller.
Ramp to Fault mode	When the present output value changes to the Fault value after a communication fault occurs.

The maximum rate of change in outputs is expressed in engineering units per second (Engineering Units/second) and called the maximum ramp rate.

To see where to set Ramping, see page 133.

Hold for Initialization

Hold for Initialization causes outputs to hold present state until the value commanded by the controller matches the value at the output screw terminal within 0.1% of full scale, providing a bumpless transfer.

If Hold for Initialization is selected, outputs hold if there is an occurrence of any of these three conditions:

- Initial connection is established after power up.
- A new connection is established after a communication fault occurs.
- There is a transition to Run mode from Program state.

The *I.Ch[x].InHold* tag for a channel indicates that the channel is holding.

Clamping/Limiting

Clamping limits the output from the analog module to remain within a range configured by the controller, even when the controller commands an output outside that range. This safety feature sets a high clamp and a low clamp.

Once clamps are determined for a module and enabled, any data received from the controller that exceeds those clamps sets an appropriate limit alarm and transitions the output to that limit but not beyond the requested value.

For example, an application can set the high clamp on a module for 8V and the low clamp for -8V. If a controller sends a value corresponding to 9V to the module, the module applies only 8V to its screw terminals.

You can disable or latch clamping alarms on a per channel basis. The alarms are disabled by default.

IMPORTANT

Clamp values are in engineering units and are **not automatically updated** when the scaling high and low engineering units are changed. Failure to update the clamp values can generate a very small output signal that could be misinterpreted as a hardware problem.

For example, a 1756-OF8I module channel that uses a Current (mA) output type with Clamping enabled has the following configuration parameters:

- Scaling values:
  - High Engineering = 100.0000%
  - Low Engineering = 0.0000%
- Clamp Limits:
  - High Clamp = 100.0000%
  - Low Clamp = 0.0000%

If you change the Scaling High Engineering value to 90.0000%, the High Clamp value remains at 100.0000.

You must change the High Clamp value to 90.0000 to make sure the application continues to operate as expected.

Clamp/Limit Alarms

This function works directly with clamping. When a module receives a data value from the controller that exceeds clamping limits, it applies signal values to the clamping limit but also sends a status bit to the controller notifying it that the value sent exceeds the clamping limits.

With the previous example, if a module has clamping limits of 8V and -8V but then receives data to apply 9V, only 8V is applied to the screw terminals and the module sends a status bit back to the controller informing it that the 9V value exceeds the module's clamping limits.

To see where to set clamp and limit alarms, see page 133.

Data Echo

Data Echo automatically multicasts channel data values that match the analog value that was sent to the module's screw terminals at that time.

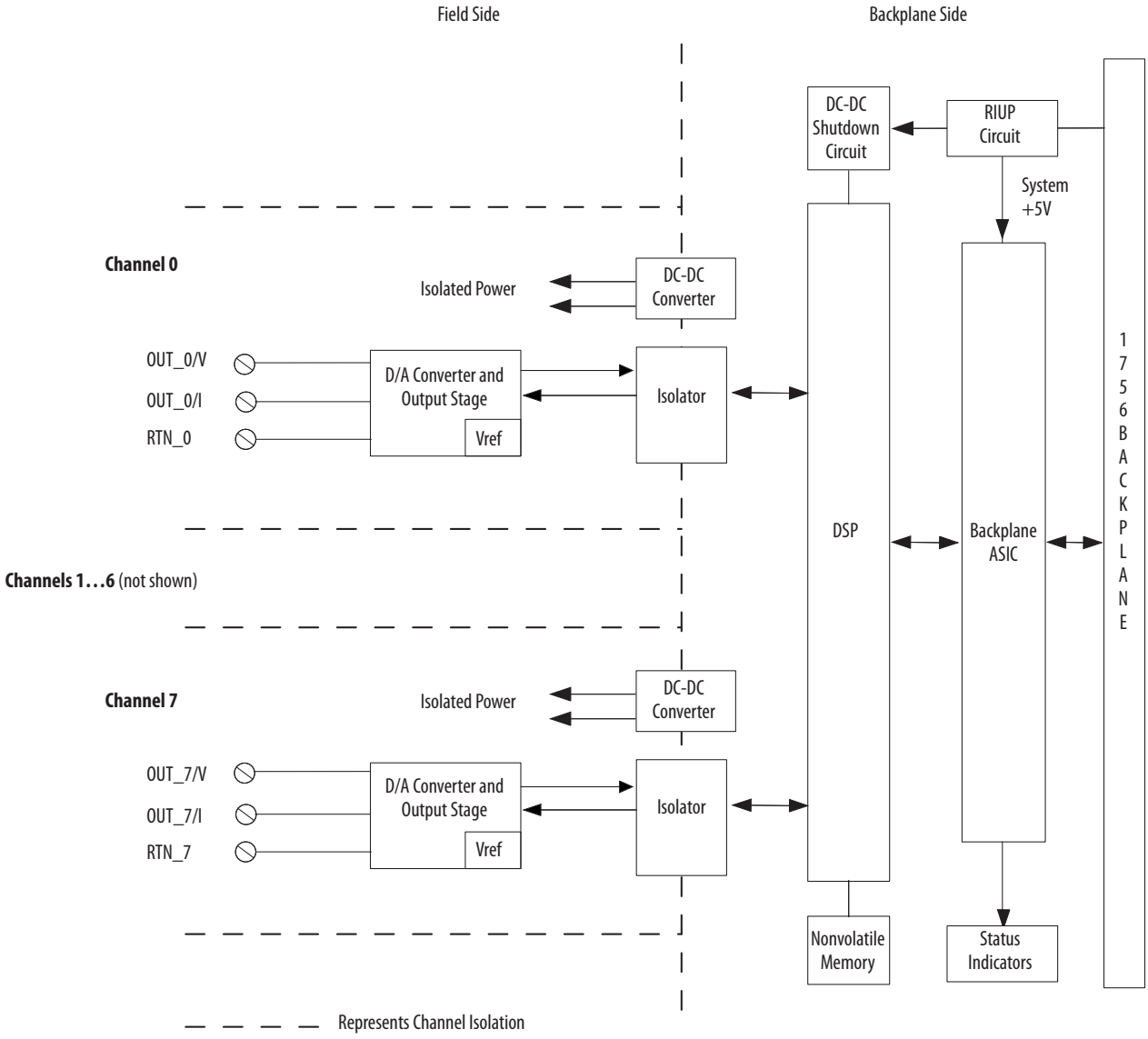
The 1756-OF8I module returns a status word that represents the value sent to it by the controller. The echoed value is indicated in input tag *I.Ch[x].Data* and is represented in Engineering Units.

Fault and status data are also sent. This data is sent at the RPI.

Module Block and Output Circuit Diagrams

The graphics in this section show the 1756-OF8I module's block diagrams and input circuit diagrams.

Figure 20 - 1756-OF8I Module Block Diagram



Field-side Circuit Diagrams

The following diagrams show the field-side circuitry for the 1756-OF8I module.

Figure 21 - 1756-OF8I Module Field-side Circuit with Current Output

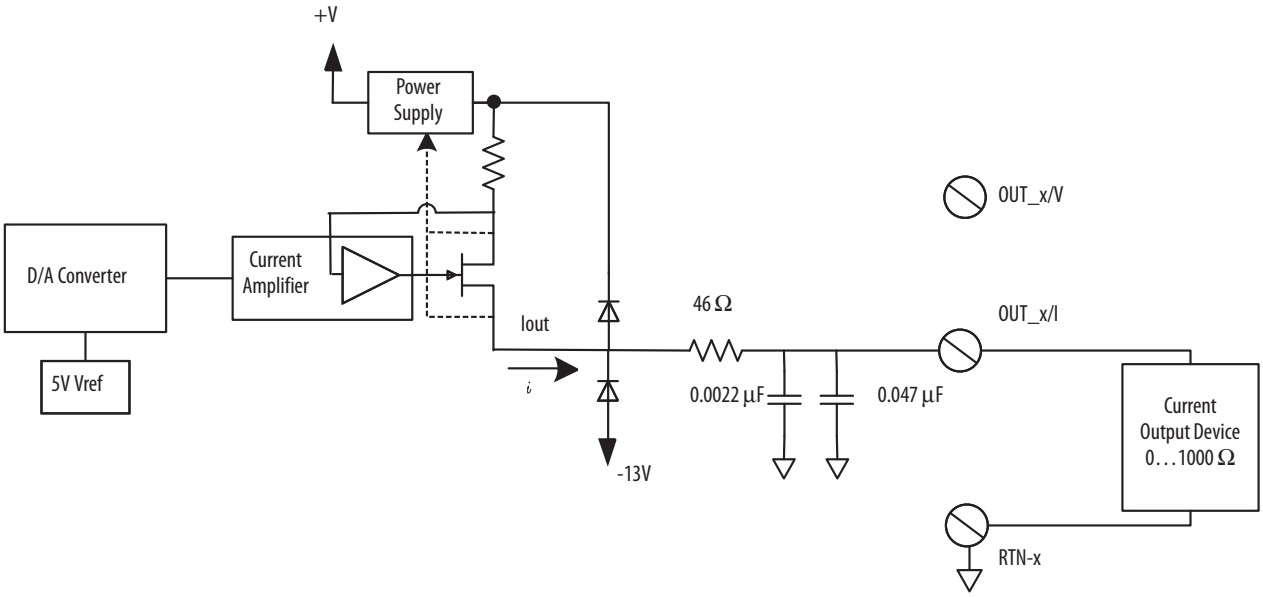
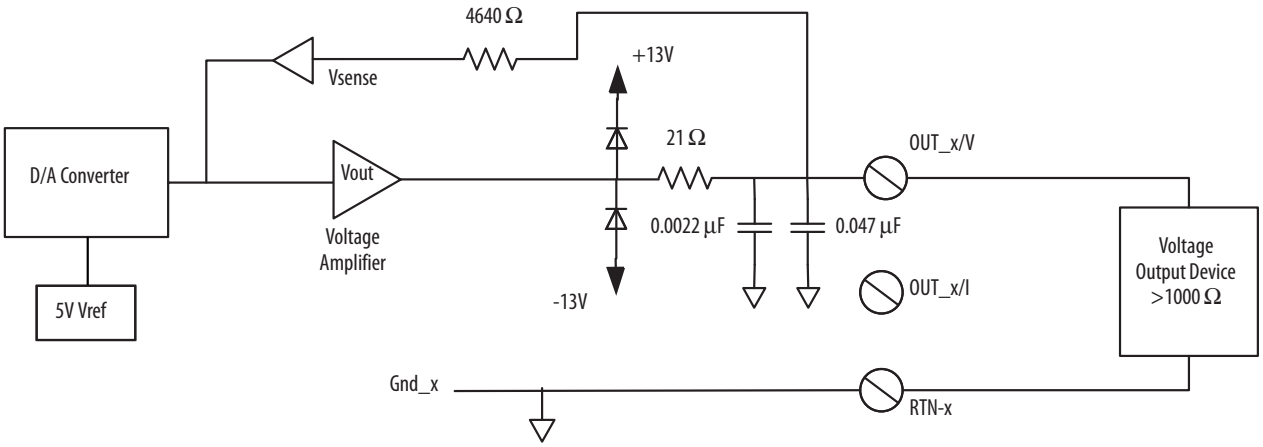


Figure 22 - 1756-OF8I Module Field-side Circuit with Voltage Output



Drive Different Loads with the 1756-OF8I Module

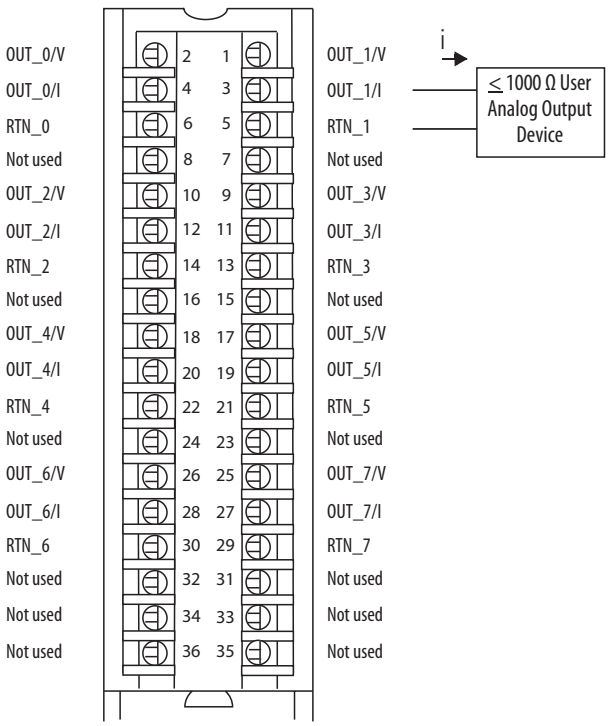
When the 1756-OF8I module operates with a Current output load, each channel automatically adjusts its output power for 0...1000 ohm loads. The module's 24V backplane current requirements vary based on load.

For more information the module's 24V current requirements, see the 1756 ControlLogix I/O Specifications Technical Data, publication 1756-TD002.

Wire the 1756-OF8I Module

The following graphic show wiring examples for the 1756-OF8I module with current and voltage output types.

Figure 23 - 1756-OF8I Module Wiring Diagram - Current Output Type



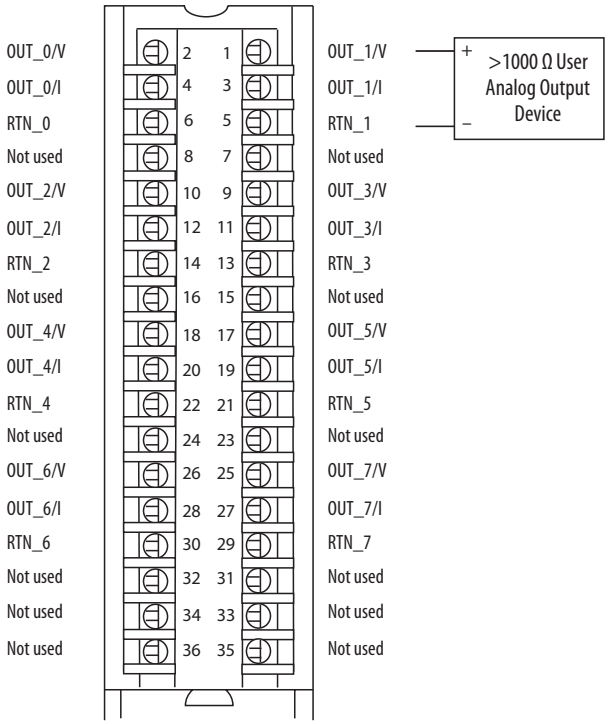
IMPORTANT: Remember the following:

- If separate power sources are used, do not exceed the specific isolation voltage. For more information on module specifications, see the 1756 ControlLogix I/O Specifications Technical Data, publication 1756-TD002.
- Place additional devices anywhere in the loop.

IMPORTANT: Remember the following:

- If separate power sources are used, do not exceed the specific isolation voltage. For more information on module specifications, see the 1756 ControlLogix I/O Specifications Technical Data, publication 1756-TD002.
- Place additional devices anywhere in the loop.

Figure 24 - 1756-OF8I Module Wiring Diagram - Voltage Output Type



Fault and Status Reporting

The 1756-OF8I module multicasts fault and status data with channel data to the owner and listening controllers. The data is returned via module tags that you can monitor in your Logix Designer application.

With some exceptions, as noted in the following table, the 1756-OF8I module provides the fault and data status in a channel-centric format.

The following table lists the 1756-OF8I module's fault and status tags available in the Logix Designer application.

Table 15 - 1756-OF8I Module - Fault and Status Data Tags

Data Type	Tag Name	Triggering Event That Sets Tag
Fault	Fault(1)	The owner-controller loses its connection to the module.
	Ch[x].Fault	The channel data quality is bad.
Status	CIPSyncValid(1)	Indicates whether the module has synchronized to a valid CIP Sync time master on the backplane.
	CIPSyncTimeout(1)	Indicates whether a valid time master on the backplane has timed out.
	CIPSyncOffsetJump(1)	Indicates a significant jump, that is, 1 ms or greater, in the CST and CIP Sync times sent from the Timemaster to the module. (The Timemaster sends the CST and CIP Sync times to the module every second.) When a significant jump occurs, this tag value becomes 1 but changes to 0 a second later unless another jump occurred.
	Ch[x].Uncertain	The channel data can be imperfect.
	Ch[x].LowClampAlarm	The following events occur: • Clamping is enabled on this channel. • One of the following: – The channel data requested, indicated in the *O.Ch[x].Data* tag, is currently less than the configured LowLimit. – Latching is enabled and the *O:Ch[x].Data* tag was less than the configured LowLimit at some points and the alarm has not been unlatched.
	Ch[x].HighClampAlarm	The following events occur: • Clamping is enabled on this channel. • One of the following: – The channel data requested, indicated in the *O.Ch[x].Data* tag, is currently greater than the configured HighLimit. – Latching is enabled and the *O:Ch[x].Data* tag was greater than the configured HighLimit at some points and the alarm has not been unlatched.
	Ch[x].RampAlarm	The channel is currently limited to changing the output at the Maximum Ramp rate or once was and is now latched.
	Ch[x].NotANumber	The most recently-received data value was not a number.
	Ch[x].InHold	The channel is currently holding until the received channel data is within 0.1% of the current channel data value.
	Ch[x].CalibrationFault	The last attempted Calibration for this channel failed.
	Ch[x].Calibrating	The channel is currently being calibrated.
	Ch[x].CalGoodLowRef	A valid Low Reference signal has been sampled on this channel.
	Ch[x].CalBadLowRef	An invalid Low Reference signal has been sampled on this channel.
	Ch[x].CalGoodHighRef	An valid High Reference signal has been sampled on this channel.
	Ch[x].CalBadHighRef	An invalid High Reference signal has been sampled on this channel.
	Ch[x].CalSuccessful	Calibration on this channel is complete and the Calibrating state has been exited.
	Ch[x].Data	The channel data in scaled Engineering Units. This data is the Output Data Echo data returned from the D/A convertor.
	Timestamp(1)	A 64-bit Timestamp indicating when any one of the output channels was last updated with new output data in terms of CIPSync time.
	RollingTimestamp	16 bit timestamp that 'rolls' from 0…32,767 ms. Compatible with existing PID instruction to automatically calculate sample deltas.

(1) This tag provides module-wide data and affects all channels simultaneously.

Install ControlLogix Isolated Analog I/O Modules

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Assemble the RTB and the Housing	114
Choose Extended-depth Housing	115
Install the Removable Terminal Block	117
Remove the Removable Terminal Block	118
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This chapter assumes that you have already installed a 1756 ControlLogix chassis and power supply. If not, do so before proceeding.

ATTENTION: Environment and Enclosure

This equipment is intended for use in a Pollution Degree 2 industrial environment, in overvoltage Category II applications (as defined in EN 60664-1), at altitudes up to 2000 m (6562 ft) without derating.

This equipment is not intended for use in residential environments and may not provide adequate protection to radio communication services in such environments.

This equipment is supplied as open-type equipment. It must be mounted within an enclosure that is suitably designed for those specific environmental conditions that will be present and appropriately designed to prevent personal injury resulting from accessibility to live parts. The enclosure must have suitable flame-retardant properties to prevent or minimize the spread of flame, complying with a flame spread rating of 5VA or be approved for the application if nonmetallic. The interior of the enclosure must be accessible only by the use of a tool. Subsequent sections of this publication may contain additional information regarding specific enclosure type ratings that are required to comply with certain product safety certifications.

In addition to this publication, see the following:

- Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1, for additional installation requirements
- NEMA 250 and EN 60529, as applicable, for explanations of the degrees of protection provided by different types of enclosure

North American Hazardous Location Approval

The following information applies when operating this equipment in hazardous locations.	**Informations sur l'utilisation de cet équipement en environnements dangereux.**
Products marked "CL I, DIV 2, GP A, B, C, D" are suitable for use in Class I Division 2 Groups A, B, C, D, Hazardous Locations and nonhazardous locations only. Each product is supplied with markings on the rating nameplate indicating the hazardous location temperature code. When combining products within a system, the most adverse temperature code (lowest "T" number) may be used to help determine the overall temperature code of the system. Combinations of equipment in your system are subject to investigation by the local Authority Having Jurisdiction at the time of installation.	Les produits marqués "CL I, DIV 2, GP A, B, C, D" ne conviennent qu'à une utilisation en environnements de Classe I Division 2 Groupes A, B, C, D dangereux et non dangereux. Chaque produit est livré avec des marquages sur sa plaque d'identification qui indiquent le code de température pour les environnements dangereux. Lorsque plusieurs produits sont combinés dans un système, le code de température le plus défavorable (code de température le plus faible) peut être utilisé pour déterminer le code de température global du système. Les combinaisons d'équipements dans le système sont sujettes à inspection par les autorités locales qualifiées au moment de l'installation.
WARNING: EXPLOSION HAZARD • Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous. • Do not disconnect connections to this equipment unless power has been removed or the area is known to be nonhazardous. Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product. • Substitution of components may impair suitability for Class I, Division 2. • If this product contains batteries, they must only be changed in an area known to be nonhazardous.	**AVERTISSEMENT: RISQUE D'EXPLOSION** • Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher l'équipement. • Couper le courant ou s'assurer que l'environnement est classé non dangereux avant de débrancher les connecteurs. Fixer tous les connecteurs externes reliés à cet équipement à l'aide de vis, loquets coulissants, connecteurs filetés ou autres moyens fournis avec ce produit. • La substitution de composants peut rendre cet équipement inadapté à une utilisation en environnement de Classe I, Division 2. • S'assurer que l'environnement est classé non dangereux avant de changer les piles.

European Hazardous Location Approval

The following applies when the product bears the Ex Marking.

This equipment is intended for use in potentially explosive atmospheres as defined by European Union Directive 94/9/EC and has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of Category 3 equipment intended for use in Zone 2 potentially explosive atmospheres, given in Annex II to this Directive. Compliance with the Essential Health and Safety Requirements has been assured by compliance with EN 60079-15 and EN 60079-0.

WARNING:

- This equipment shall be mounted in an ATEX-certified enclosure with a minimum ingress protection rating of at least IP54 (as defined in IEC60529) and used in an environment of not more than Pollution Degree 2 (as defined in IEC 60664-1) when applied in Zone 2 environments. The enclosure must have a tool-removable cover or door.
- This equipment shall be used within its specified ratings defined by Rockwell Automation.
- Provision shall be made to prevent the rated voltage from being exceeded by transient disturbances of more than 140% of the rated voltage when applied in Zone 2 environments.
- This equipment must be used only with ATEX certified Rockwell Automation backplanes.
- Secure any external connections that mate to this equipment by using screws, sliding latches, threaded connectors, or other means provided with this product.
- Do not disconnect equipment unless power has been removed or the area is known to be nonhazardous.

Install the I/O Module

You can install or remove a module while chassis power is applied.Removal and Insertion Under Power (RIUP) provides the flexibility to maintain modules without having to stop production.

WARNING: When you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding. Repeated electrical arcing causes excessive wear to contacts on both module and its mating connector. Worn contacts may create electrical resistance that can affect module operation.

ATTENTION: The module is designed to support Removal and Insertion Under Power (RIUP). However, when you remove or insert an RTB with field-side power applied, unintended machine motion or loss of process control can occur. Exercise extreme caution when using this feature.

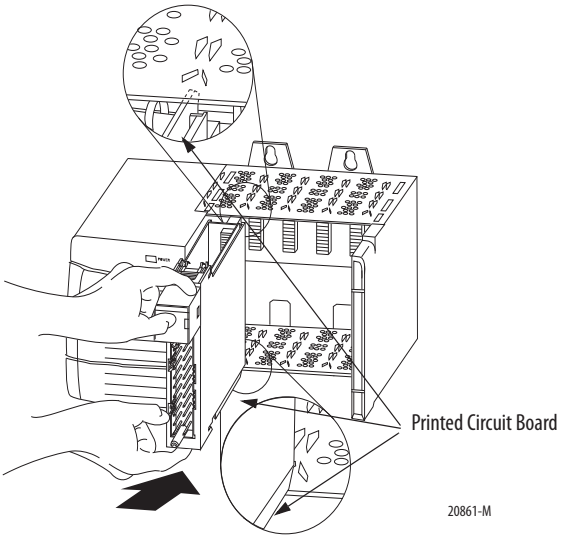
ATTENTION: Prevent Electrostatic Discharge

This equipment is sensitive to electrostatic discharge, which can cause internal damage and affect normal operation. Follow these guidelines when you handle this equipment:

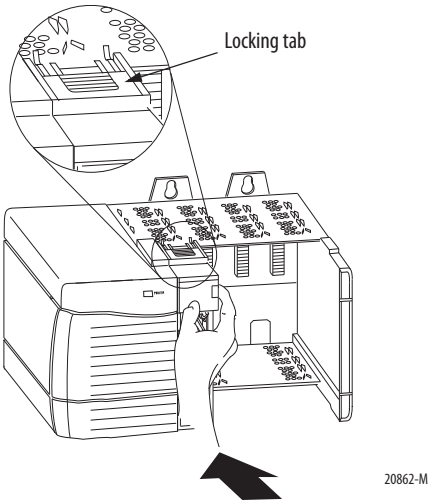
- Touch a grounded object to discharge potential static.
- Wear an approved grounding wriststrap.
- Do not touch connectors or pins on component boards.
- Do not touch circuit components inside the equipment.
- Use a static-safe workstation, if available.
- Store the equipment in appropriate static-safe packaging when not in use.

Complete these steps to install an I/O module.

1. Align the circuit board with the top and bottom chassis guides.



2. Slide the module into the chassis until the module locking tab clicks.



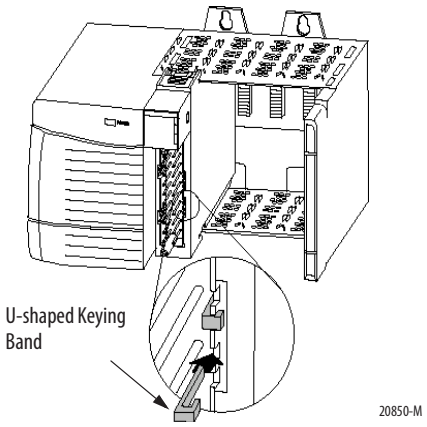
Key the Removable Terminal Block

Key the removable terminal block (RTB) to prevent inadvertently connecting the wrong wiring in the RTB to your module. Wedge- and U-shaped bands are manually inserted into the RTB and module. This process hinders a wired RTB from being accidentally inserted into a module that does not match the positioning of the respective tabs.

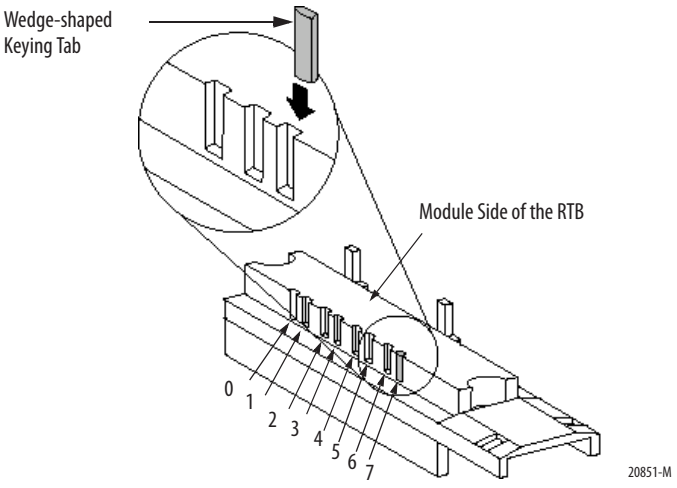
Key positions on the module that correspond to unkeyed positions on the RTB. For example, if you place a U-shaped keying band in slot 4 on the module, you cannot place a wedge-shaped tab in slot 4 on the RTB or your RTB does not mount on the module. We recommend that you use a unique keying pattern for each slot in the chassis.

Complete the following steps to key the RTB.

1. Insert the U-shaped band with the long side near the terminals.
2. Push the band onto the module until it snaps into place.



3. Key the RTB in positions that correspond to unkeyed module positions.
4. Insert the wedge-shaped tab on the RTB with the rounded edge first.



5. Push the tab onto the RTB until it stops.

Connect Wiring

Connect wiring to the module with an RTB or a Bulletin 1492 pre-wired Analog Interface Module (AIFM). This section describes how to wire the module with an RTB. If you are using an AIFM to connect wiring, see the documentation for that product.

IMPORTANT We recommend that you use Belden 8761 cable when wiring the RTB for the following ControlLogix isolated analog modules:

- 1756-IF8I
- 1756-OF8I
- 1756-IRT8I on points that use the Thermocouple functionality

We recommend that you use Belden 9533 or 83503 cable with the 1756-IRT8I module on points that use the RTD functionality.

WARNING: If you connect or disconnect wiring while the field-side power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations. Be sure that power is removed or the area is nonhazardous before proceeding.

ATTENTION: If multiple power sources are used, do not exceed the specified isolation voltage.

ATTENTION: The ControlLogix system has been agency certified using only the ControlLogix RTBs (catalog numbers 1756-TBCH, 1756-TBNH, 1756-TBSH and 1756-TBS6H). Any application that requires agency certification of the ControlLogix system using other wiring termination methods may require application specific approval by the certifying agency.

Connect the Grounded End of the Cable

Before wiring the RTB, you must connect the ground wiring.

IMPORTANT We recommend that you ground the following ControlLogix isolated analog module shield and drain wires at the field-side:

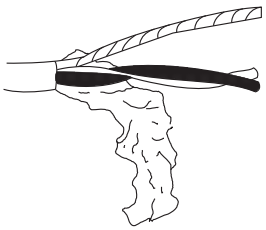
- 1756-OF8I
- 1756-IRT8I
- 1756-IF8I on points that use the non-sourcing current/voltage functionality

If you cannot ground the module shield and drain wires at field-side, ground them at an earth ground on the chassis.

We recommend that you always **ground the 1756-IF8I module at an earth ground on the chassis** when you use the module's **current sourcing functionality**.

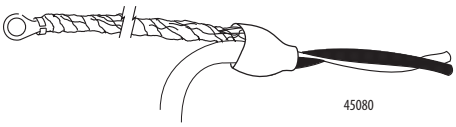
1. Remove a length of cable jacket from the Belden cable.

2. Pull the foil shield and bare drain wire from the insulated wire.



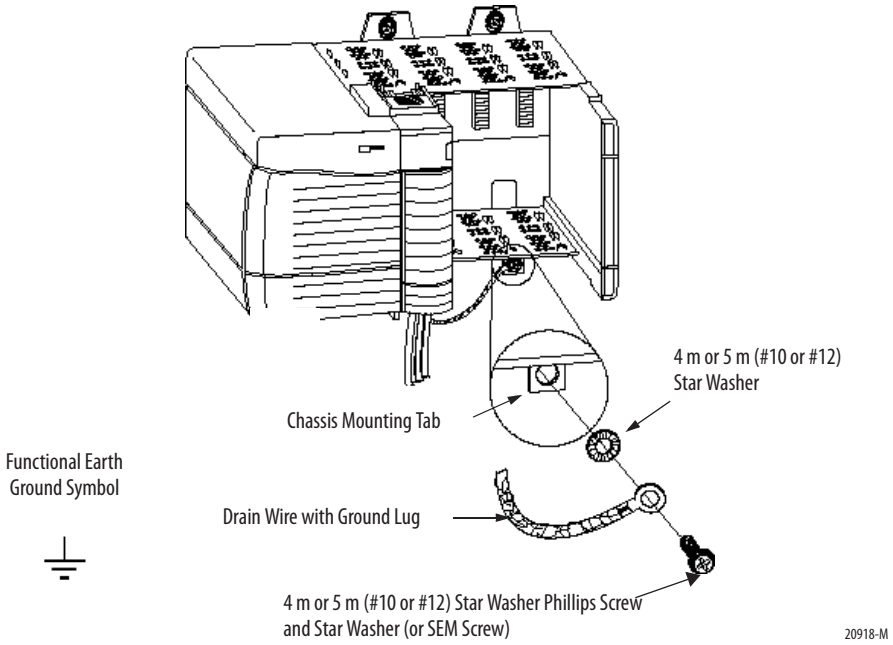
3. Twist the foil shield and drain wire together to form a single strand.

4. Attach a ground lug and apply heat shrink tubing to the exit area.



5. Connect the drain wire to a chassis mounting tab.

   Use any chassis mounting tab that is designated as a functional signal ground. The functional earth ground symbol appears near the tab.


4 m or 5 m (#10 or #12)
Star Washer
Chassis Mounting Tab
Functional Earth
Ground Symbol
Drain Wire with Ground Lug
4 m or 5 m (#10 or #12) Star Washer Phillips Screw
and Star Washer (or SEM Screw)
20918-M

6. When the drain wire is grounded, connect the insulated wires to the field-side.

Connect the Ungrounded End of the Cable

1. Cut the foil shield and drain wire back to the cable casing and apply shrink wrap.
2. Connect the insulated wires to the RTB.

RTB Types

Each RTB comes with housing. The following RTB types work with ControlLogix isolated analog I/O modules:

- Cage Clamp RTB - Catalog Number 1756-TBCH
- Spring Clamp RTB - Catalog Number 1756-TBS6H

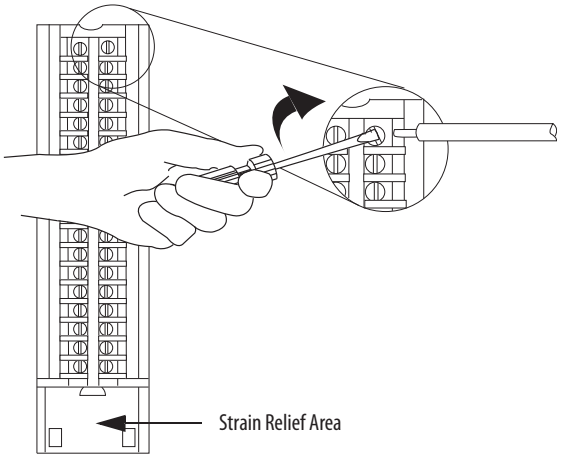
ATTENTION: Consider the following when using the 1756-TBCH RTB:

- Do not wire more than two 0.33...1.3 mm^2 (22...16 AWG) conductors on any single terminal.
- You can connect only one 2.1 mm^2 (14 AWG) conductor to any single terminal.
- Use only the same size wires with no intermixing of solid and stranded wire types.

When using the 1756-TBS6H RTB, do not wire more than one conductor on any single terminal.

Cage Clamp RTB - Catalog Number 1756-TBCH

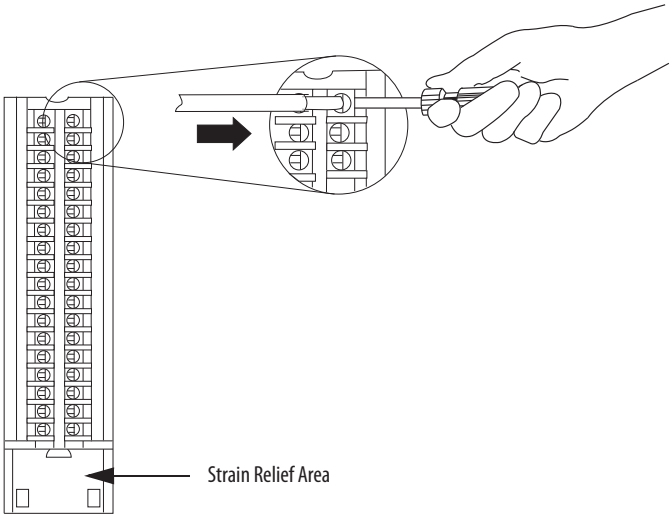
1. Strip 9.5 mm (3.8 in.) maximum length of wire.
2. Insert the wire into the open terminal on the side.
3. Turn the screw clockwise to close the terminal on the wire.



The open section at the bottom of the RTB is called the strain relief area. The wiring from the connections can be grouped with a plastic tie.

Spring Clamp RTB - Catalog Number 1756-TBS6H

1. Strip 11 mm (7/16 in.) maximum length of wire.
2. Insert the screwdriver into the outer hole of the RTB to depress the spring-loaded clamp.
3. Insert the wire into the open terminal and remove the screwdriver.
4. Insert the wire into the open terminal and remove the screwdriver.



IMPORTANT Make sure the wire, and not the screwdriver, is inserted into the open terminal to prevent damage to the module.

The open section at the bottom of the RTB is called the strain relief area. The wiring from the connections can be grouped with a plastic tie.

RTB Wiring Recommendations

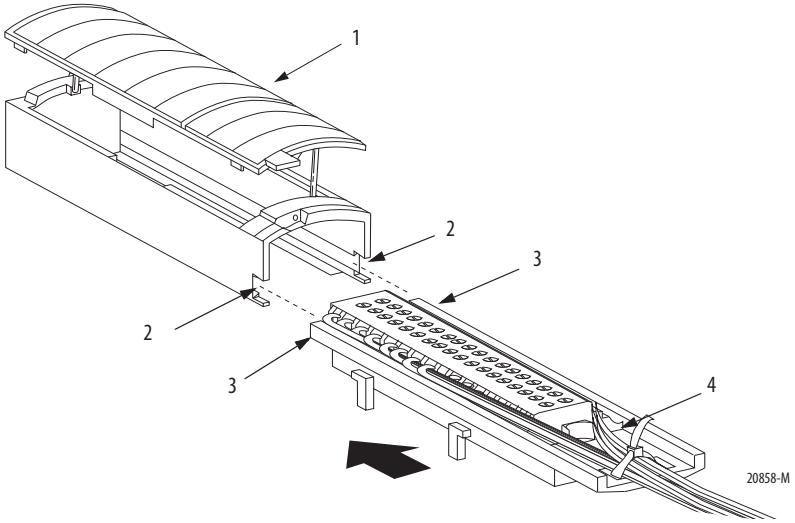
Consider these guidelines when wiring your RTB.

- Begin wiring the RTB at the bottom terminals and move up.
- Use a tie to secure the wires in the strain relief (bottom) area of the RTB.
- For applications that require heavy gauge wiring, order and use an extended-depth housing, catalog number 1756-TBE. For more information, see page 115.

Assemble the RTB and the Housing

Removable housing covers the wired RTB to protect wiring connections when the RTB is seated on the module.

1. Align the grooves at the bottom of each side of the housing with the side edges of the RTB.
2. Slide the RTB into the housing until it snaps into place.



Item	Description
1	Housing cover
2	Groove
3	Side edge of RTB
4	Strain relief area

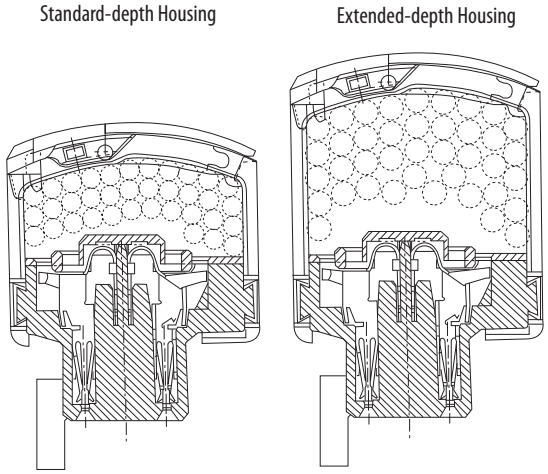
IMPORTANT If additional wire routing space is required for your application, use the extended-depth housing, catalog number 1756-TBE.

Choose Extended-depth Housing

There are two housing options available when wiring your ControlLogix isolated analog I/O module:

- Standard-depth housing
- Extended-depth housing

When you order an RTB for your I/O module, you receive standard-depth housing. If your application uses heavy gauge wiring, you can order extended-depth housing. Extended-depth housing does not come with an RTB.

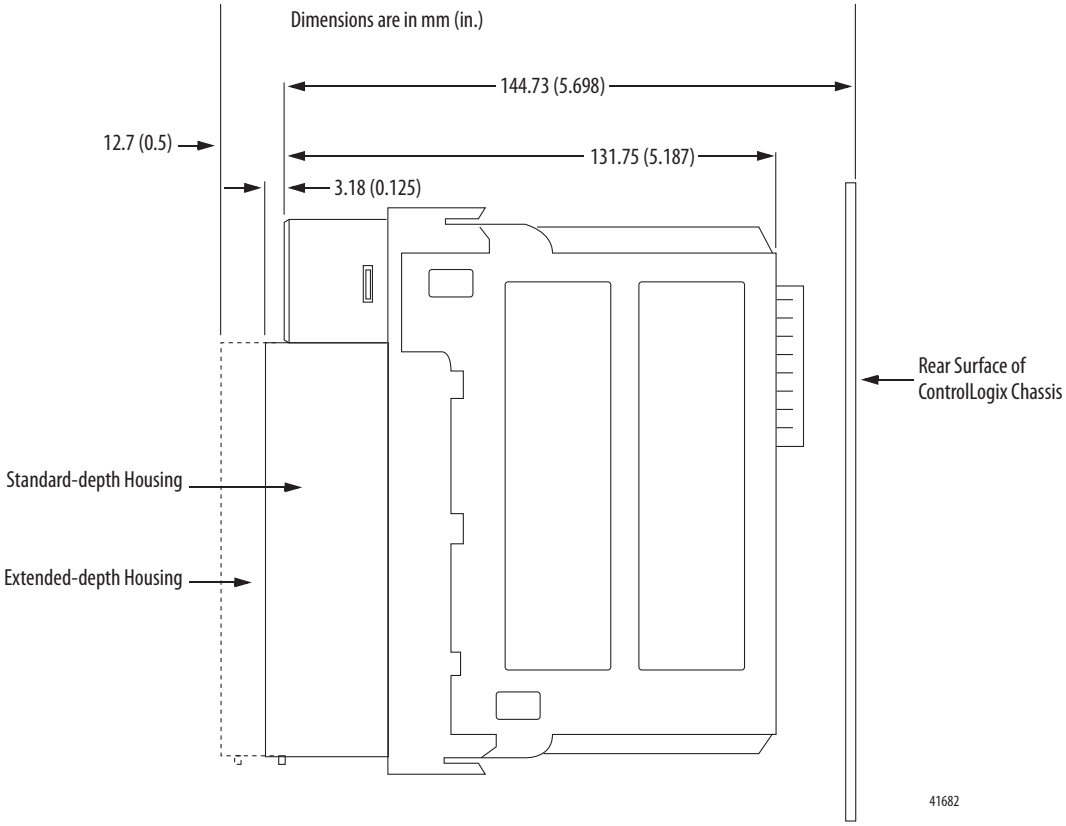


IMPORTANT The housings shown are used with a spring clamp RTB, but the capacity for each remains the same regardless of RTB type.

Cat. No.	RTB Type	Wire Capacity	Number of Wires
1756-TBCH	Cage clamp	Standard-depth 336 mm^2 (0.52 $in.^2$)	36 - 18 AWG wires 23 - 14 AWG wires
1756-TBS6H	Spring clamp		
1756-TBE	Any RTB that uses heavy gauge wiring	Extended-depth 628 mm^2 (0.97 $in.^2$)	40 - 14 AWG wires

Cabinet Size Considerations with Extended-depth Housing

When you use extended-depth housing, catalog number 1756-TBE, the I/O module depth is increased. The diagram shows the difference in depth between an I/O module using standard-depth housing and one using extended-depth housing.



IMPORTANT The depth from the front of the module to the back of the chassis is as follows:

- Standard-depth housing = 147.91 mm (5.823 in.)
- Extended-depth housing = 157.43 mm (6.198 in.)

Install the Removable Terminal Block

These steps show how to install the RTB onto the module to connect the wiring.

WARNING: When you connect or disconnect the removable terminal block (RTB) with field-side power applied, an electrical arc can occur. This could cause an explosion in hazardous location installations.

Be sure that power is removed or the area is nonhazardous before proceeding.

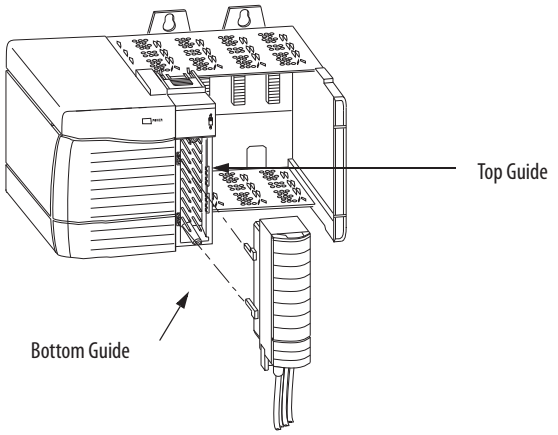
ATTENTION: Shock hazard exists. If the RTB is installed onto the module while the field-side power is applied, the RTB will be electrically live. Do not touch the RTB's terminals. Failure to observe this caution may cause personal injury.

The RTB is designed to support Removal and Insertion Under Power (RIUP). However, when you remove or insert an RTB with field-side power applied, unintended machine motion or loss of process control can occur. Exercise extreme caution when using this feature. We recommend that field-side power be removed before installing the RTB onto the module.

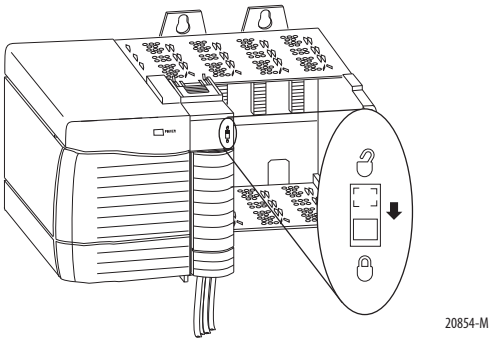
Before installing the RTB, verify the following:

- Field-side wiring of the RTB is complete.
- The RTB housing is snapped into place.
- The RTB housing door is closed.
- The locking tab at the top of the module is unlocked.

1. Align the top, bottom, and left side guides of the RTB with the guides on the module.



2. Press quickly and evenly to seat the RTB on the module until the latches snap into place.
3. Slide the locking tab down to lock the RTB onto the module.



Remove the Removable Terminal Block

If you need to remove the module from the chassis, you must first remove the RTB from the module.

WARNING: When you insert or remove the module while backplane power is on, an electrical arc can occur. This could cause an explosion in hazardous location installations.

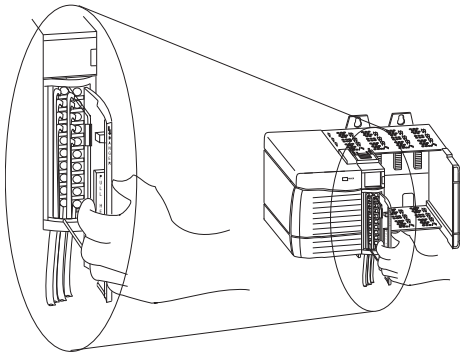
Be sure that power is removed or the area is nonhazardous before proceeding. Repeated electrical arcing causes excessive wear to contacts on both module and its mating connector. Worn contacts can create electrical resistance that can affect module operation.

ATTENTION: Shock hazard exists. If the RTB is removed from the module while the field-side power is applied, the module will be electrically live. Do not touch the RTB's terminals. Failure to observe this caution may cause personal injury.

The RTB is designed to support Removal and Insertion Under Power (RIUP). However, when you remove or insert an RTB with field-side power applied, unintended machine motion or loss of process control can occur. Exercise extreme caution when using this feature. We recommend that field-side power be removed before removing the module.

Complete the following steps to remove the RTB.

1. Unlock the locking tab at the top of the module.
2. Open the RTB door by using the bottom tab.
3. Hold the spot marked PULL HERE and pull the RTB off the module.



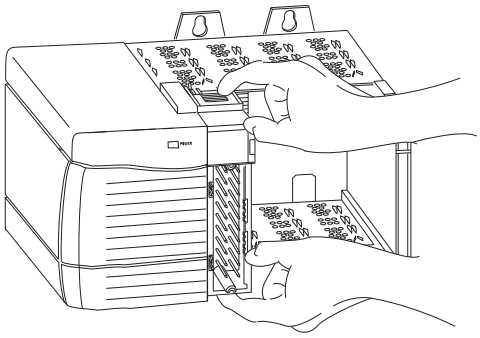
20855-M

IMPORTANT Do not wrap your fingers around the entire door. A shock hazard exists.

Remove the Module from the Chassis

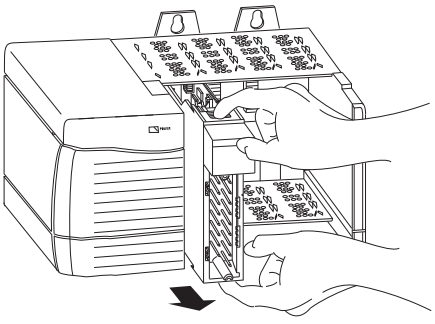
Complete the following steps to remove a module from its chassis.

1. Push in the top and bottom locking tabs.



20856-M

2. Pull the module out of the chassis.



20857-M

Notes:

Configure ControlLogix Isolated Analog I/O Modules

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Copy Channel Configuration	134
View the Module Tags	136

IMPORTANT This chapter describes how to configure you module with Logix Designer application, version 21 and later.

You can use the ControlLogix isolated analog I/O modules in RSLogix 5000 software projects as well.

You must install AOPs to use the modules in any Logix Designer application or RSLogix 5000 software project.

You must configure your isolated analog I/O module upon installation. It does not work if it is not configured.

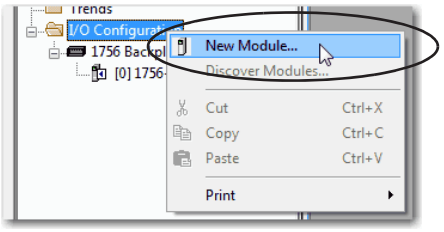
This section describes how to use the Logix Designer application to configure I/O modules in a local chassis. If you plan to use the I/O module in a remote chassis, you must add a ControlNet or EtherNet/IP communication module to the I/O configuration tree:

- For more information on the ControlLogix ControlNet module, see ControlNet Modules in Logix5000 Control Systems, publication CNET-UM001.
- For more information on the ControlLogix EtherNet/IP Bridge module, see EtherNet/IP Modules in Logix5000 Control Systems User Manual, publication ENET-UM001.

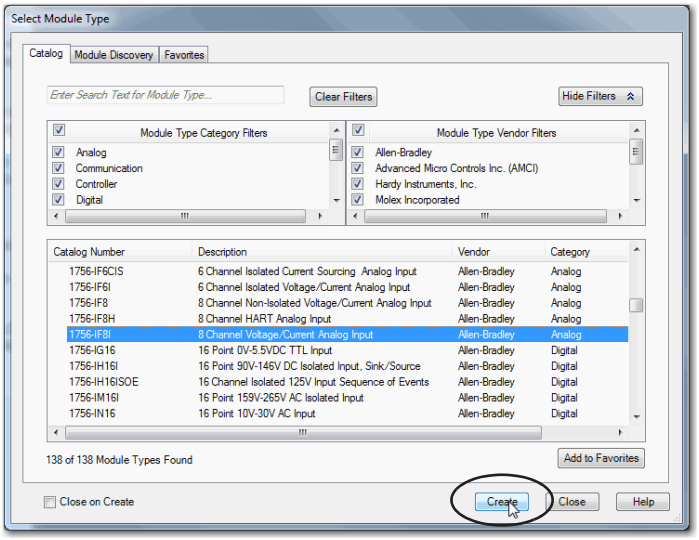
Create a New Module

After you create a Logix Designer application project, complete the following steps to create a new module in the project.

1. Right-click I/O Configuration and choose New Module.



2. Select the module and click Create.


Select Module Type
Catalog
Module Discovery
Favorites
Enter Search Text for Module Type...
Clear Filters
Hide Filters
Module Type Category Filters
Analog
Communication
Controller
Digital
Module Type Vendor Filters
Allen-Bradley
Advanced Micro Controls Inc. (AMCI)
Hardy Instruments, Inc.
Molex Incorporated
Catalog Number
Description
Vendor
Category
1756-IF6CIS 6 Channel Isolated Current Sourcing Analog Input Allen-Bradley Analog
1756-IF6I 6 Channel Isolated Voltage/Current Analog Input Allen-Bradley Analog
1756-IF8 8 Channel Non-Isolated Voltage/Current Analog Input Allen-Bradley Analog
1756-IF8H 8 Channel HART Analog Input Allen-Bradley Analog
1756-IF8I 8 Channel Voltage/Current Analog Input Allen-Bradley Analog
1756-IG16 16 Point 0V-5.5VDC TTL Input Allen-Bradley Digital
1756-IH16I 16 Point 90V-146V DC Isolated Input; Sink/Source Allen-Bradley Digital
1756-IH16ISOE 16 Channel Isolated 125V Input Sequence of Events Allen-Bradley Digital
1756-IM16I 16 Point 159V-265V AC Isolated Input Allen-Bradley Digital
1756-IN16 16 Point 10V-30V AC Input Allen-Bradley Digital
138 of 138 Module Types Found
Add to Favorites
Close on Create
Create
Close
Help

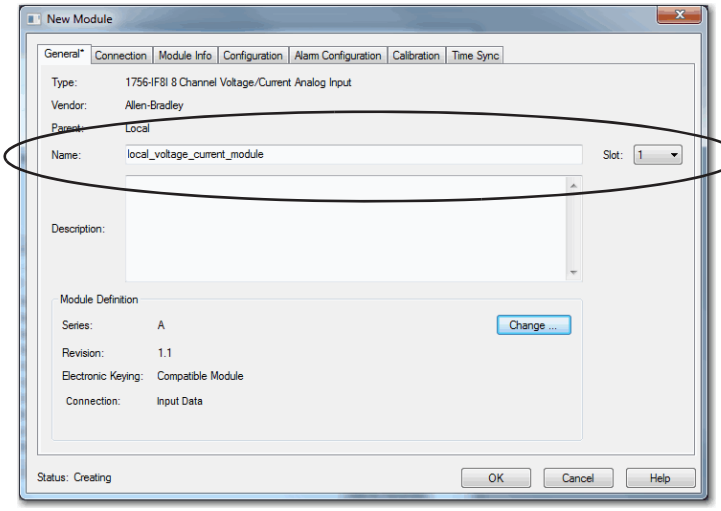
3. Click OK to accept the default major revision.

TIP You can verify the module's revision in RSLinx® Classic software.

The New Module dialog box appears.

4. On the General tab, name the module and make sure the Slot number in the configuration matches the physical slot number of the chassis housing the module.

   The Description field is optional.



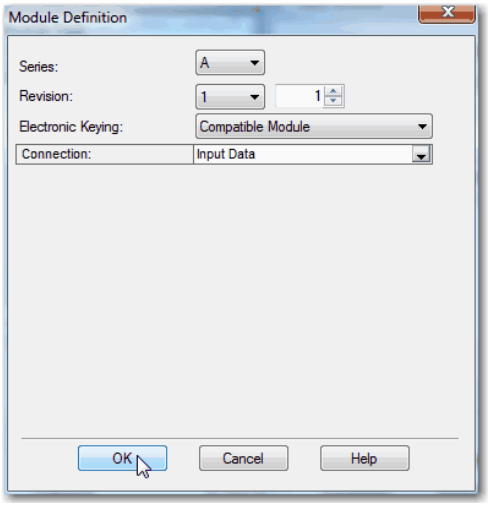
5. Click OK to accept the module's default configuration.

   The rest of this section describes how to change module configuration to work as needed in your system.

Module Definition

On the General tab, click Change ... to access the Module Definition dialog box. The following parameters are available on the Module Definition dialog box:

- Series - Module hardware series
- Revision - Module firmware revision
- Electronic Keying - For more information, see page 28.
- Connection - For more information, see page 125.



IMPORTANT When you use the Listen Only connection format, only the following tabs appear in the New Module dialog box:

- General
- Connection
- Module Info
- Time Sync

For more information on using the Listen Only connection format, see page 18.

Connection Type

The communication format determines the following for the module type you configure:

- Available configuration parameters
- Data type transferred between the module and the controller
- Which tags are generated when configuration is complete

The following table describes connection formats used with isolated analog I/O modules.

Connection Type	Definition
Input Data	All available configuration, input and output data. This connection type creates all of the appropriate controller tags for the module type being used. For example, tags specific to a channel on the 1756-IRT8I module using the RTD input type are different from those specific to a channel on the same module using the thermocouple input type.
Listen-only	Controller and module establish communication without the controller sending any configuration or output data to the module. A full input data connection is established but is dependent on the owner-controller's connection.

Edit the Configuration

You use the tabs in the New Module dialog box to edit module configuration. Some tabs show the same fields regardless of the module type you are configuring, and other tabs show fields specific to the module type.

The following tabs show the same fields regardless of module type. These tabs are not shown in this section:

- General (described beginning on page 123)
- Connection
- Module Info
- Time Sync

The following tabs show fields specific to the module type:

- Configuration
- Calibration
- Alarm Configuration - Available with only the 1756-IF8I and 1756-IRT8I modules.
- CJ Configuration - Available with only the 1756-IRT8I module.
- Limit Configuration - Available with only the 1756-OF8I module.

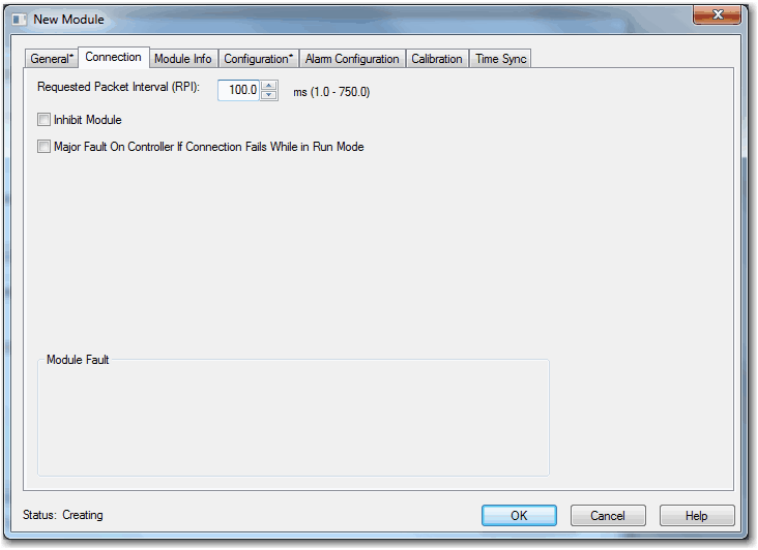
Connection Tab

The Connection tab lets you complete the following tasks:

- Set the RPI rate. For more information the RPI, see page 14.
- Inhibit the module. For more information on inhibiting the module, see page 26.
- Configure whether a connection failure while the controller is in Run module causes a major or minor fault.

The Module Fault area of the Connection tab is useful during module troubleshooting. For more information on the Module Fault area, see page 161.

The configurable parameters on this tab do not differ by module type.



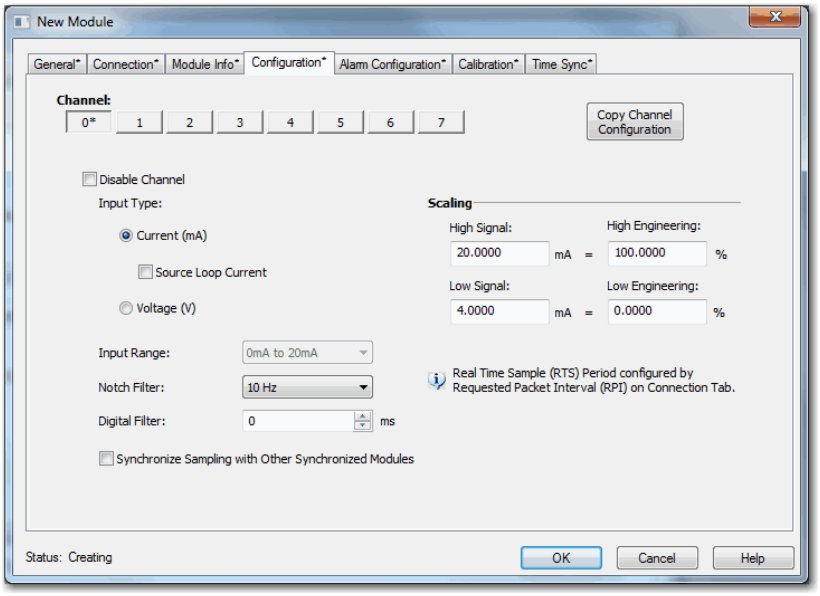
Configuration Tab

The fields on the Configuration tab are specific to the module type. The following are examples of tasks you complete via this tab:

- Select an input or output type.
- Select a module's operating range.
- Define scaling parameters.

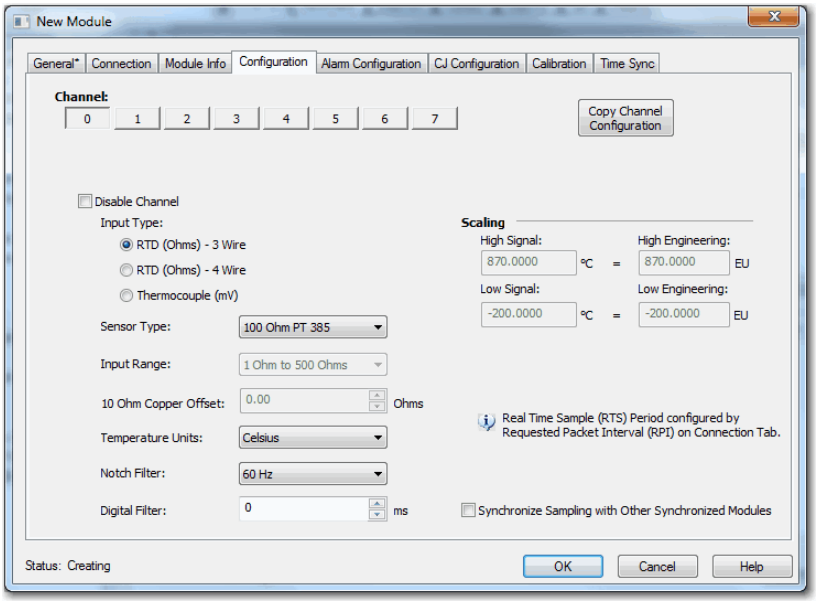
1756-IF8I Module

For information on this tab's configurable parameters, see Chapter 3, 1756-IF8I Isolated Analog Input Module on page 45.



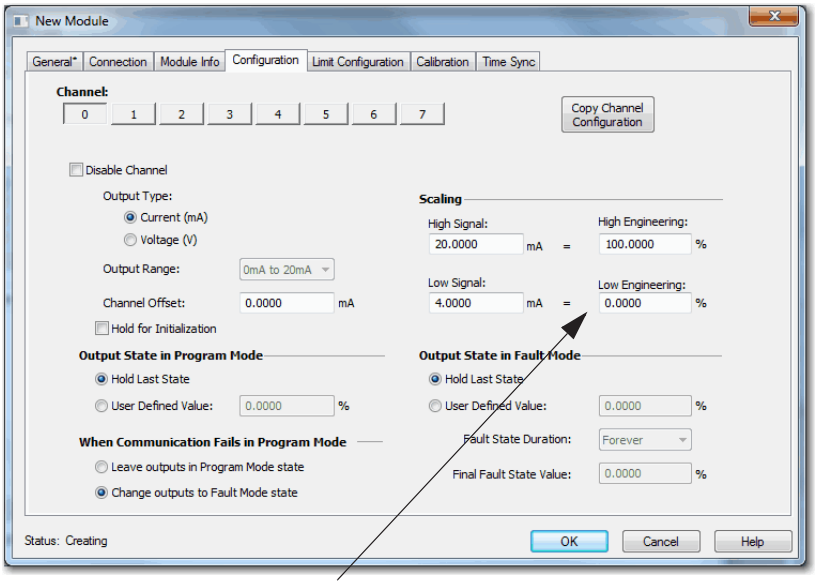
1756-IRT8I Module

For information on this tab's configurable parameters, see Chapter 4, 1756-IRT8I Combined Temperature-sensing Isolated Analog Module on page 65.



1756-OF8I Module

For information on this tab's configurable parameters, see Chapter 5, 1756-OF8I Isolated Analog Output Module on page 93.



IMPORTANT: Changes to the High Engineering and Low Engineering values do not automatically change the Clamp values on the Limit Configuration tab.

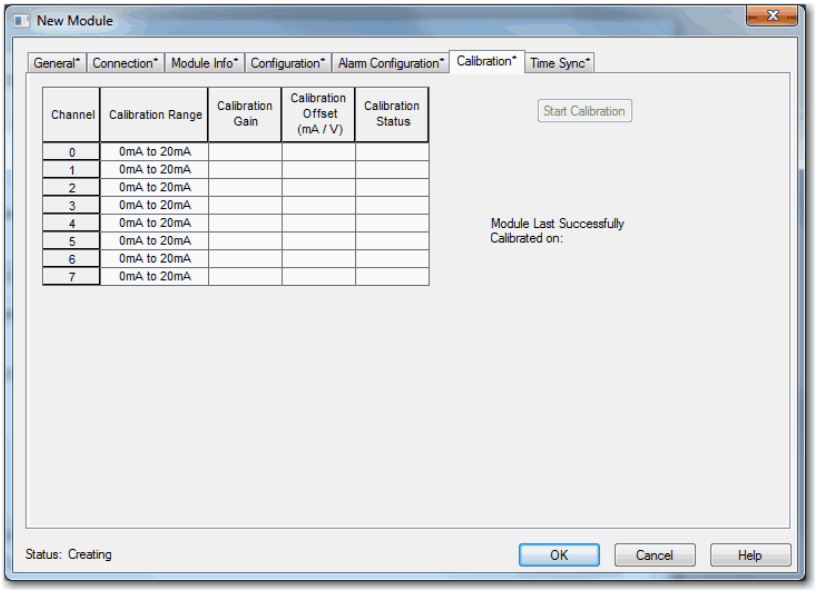
Calibration Tab

The Calibration tab lets you recalibrate the module. Calibration corrects any hardware inaccuracies on a module.

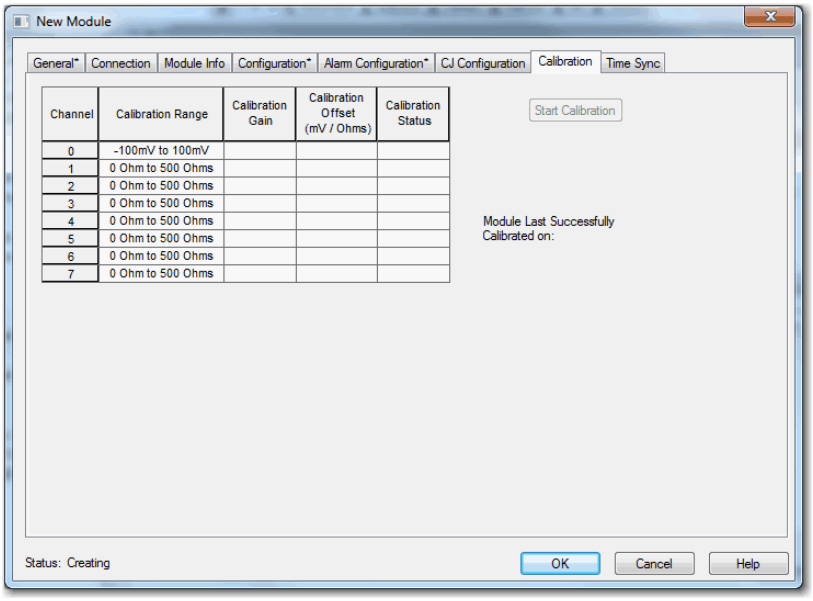
IMPORTANT	The isolated analog I/O modules do not **require** recalibration after operating in an application.

For information on how to configure each module type, see Chapter 8, Calibrate the ControlLogix Isolated Analog I/O Modules on page 137.

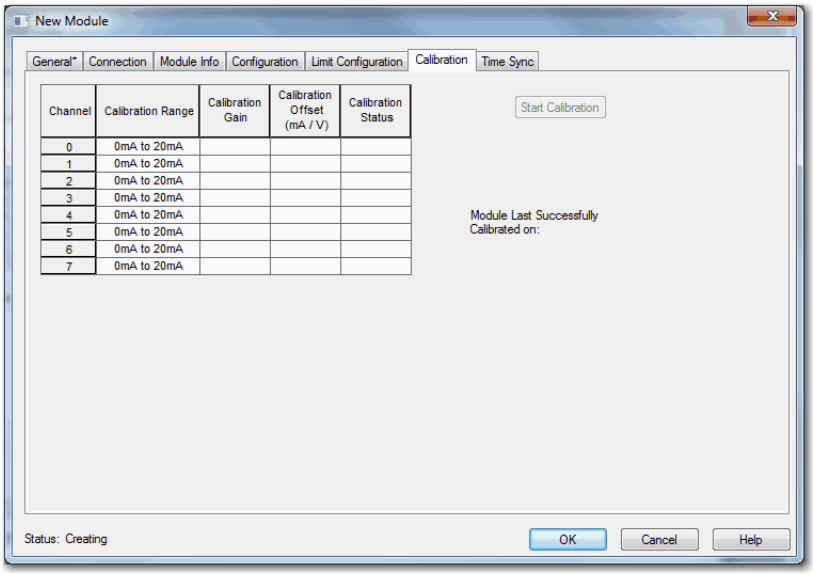
1756-IF8I Module



1756-IRT8I Module


New Module
General* Connection Module Info Configuration* Alarm Configuration* CJ Configuration Calibration Time Sync
Channel
Calibration Range
Calibration Gain
Calibration Offset (mV / Ohms)
Calibration Status
0 -100mV to 100mV
1 0 Ohm to 500 Ohms
2 0 Ohm to 500 Ohms
3 0 Ohm to 500 Ohms
4 0 Ohm to 500 Ohms
5 0 Ohm to 500 Ohms
6 0 Ohm to 500 Ohms
7 0 Ohm to 500 Ohms
Start Calibration
Module Last Successfully Calibrated on:
Status: Creating
OK
Cancel
Help

1756-OF8I Module



Alarm Configuration Tab

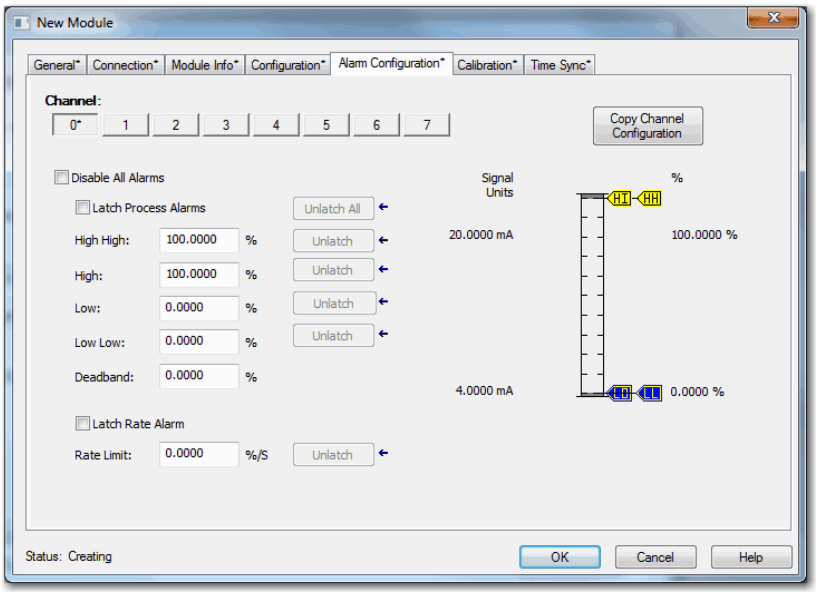
The fields on the Alarm Configuration tab are specific to the module type. The following are examples of tasks you complete via this tab:

- Disable alarms.
- Set alarm parameters.
- Set rate limits.

This tab is available only for input modules.

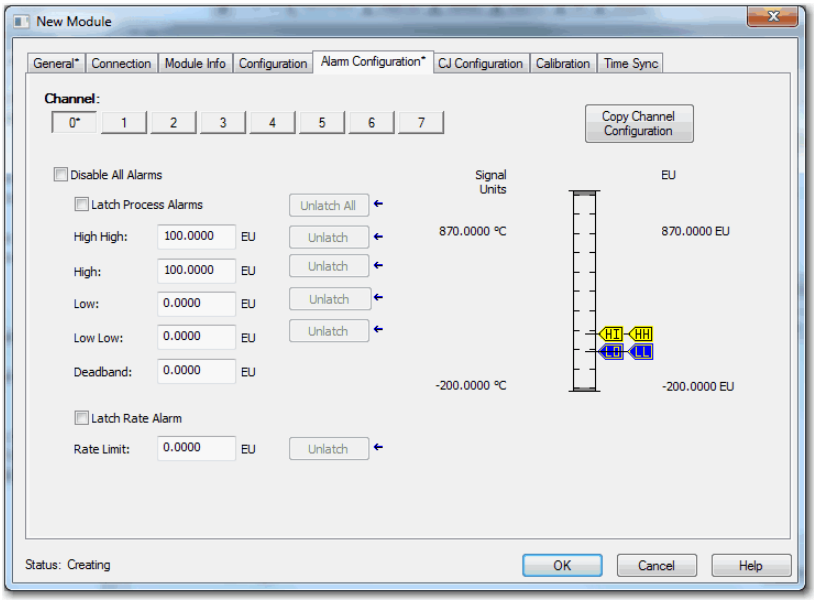
1756-IF8I Module

For information on this tab's configurable parameters, see Chapter 3, 1756-IF8I Isolated Analog Input Module on page 45.



1756-IRT8I Module

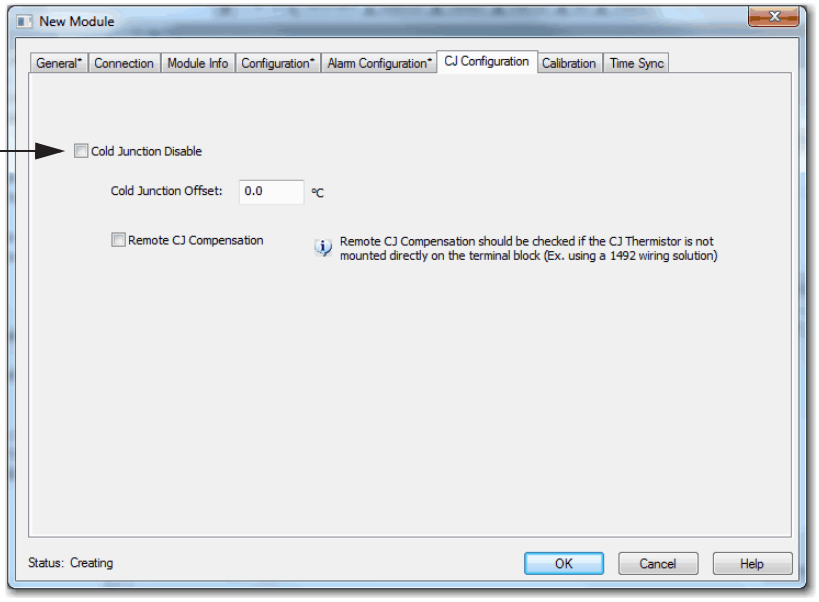
For information on this tab's configurable parameters, see Chapter 4, 1756-IRT8I Combined Temperature-sensing Isolated Analog Module on page 65.



CJ Configuration Tab

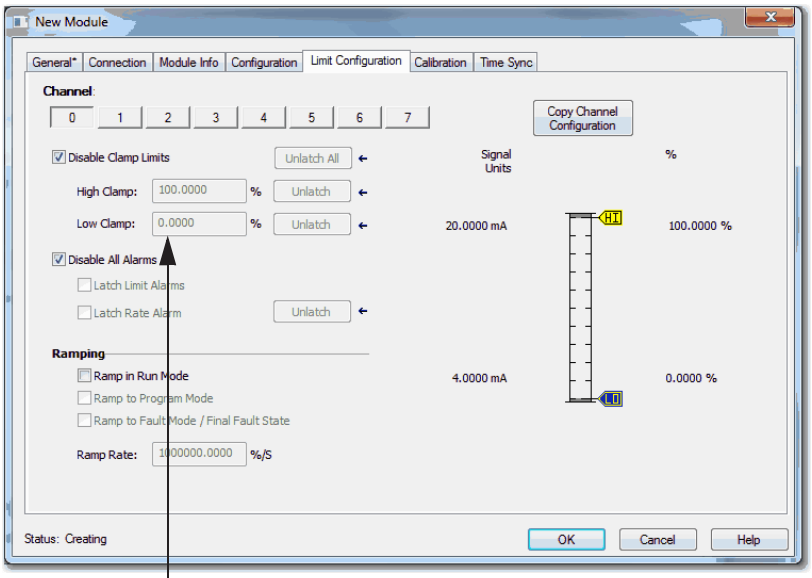
The CJ Configuration tab is available with only the 1756-IRT8I module. You use this tab to configure the cold junction compensation option.

IMPORTANT: If all channels on the module use the RTD input type, the Cold Junction Disable option appears dimmed and the checkbox is automatically checked.



Limit Configuration Tab

The Limit Configuration tab is available with only the 1756-OF8I module. You use this tab to configure clamp limits and module ramping.



IMPORTANT: Changes to the High Engineering and Low Engineering values on the Configuration tab do not change the Clamp values on this tab, when Clamp Limits are enabled.

Copy Channel Configuration

The Copy Channel Configuration feature lets you quickly and easily use the same configuration across multiple channels on a module. You can configure channel parameters on Module Properties dialog box and copy them to other channels.

Copy Channel Configuration is available on the Module Properties dialog box tabs as follows for the ControlLogix isolated analog I/O modules:

- 1756-IF8I and 1756-IRT8I modules:
  - Configuration tab
  - Alarm Configuration tab
- 1756-OF8I module:
  - Configuration tab
  - Limit Configuration tab

The Copy Channel Configuration feature copies all channel configuration from one channel to one or more other channels. For example, if you use the Copy Channel Configuration feature on the Configuration tab for a 1756-IF8I module, the configuration values on the Configuration tab and the Alarm Configuration tab are copied to the selected channels.

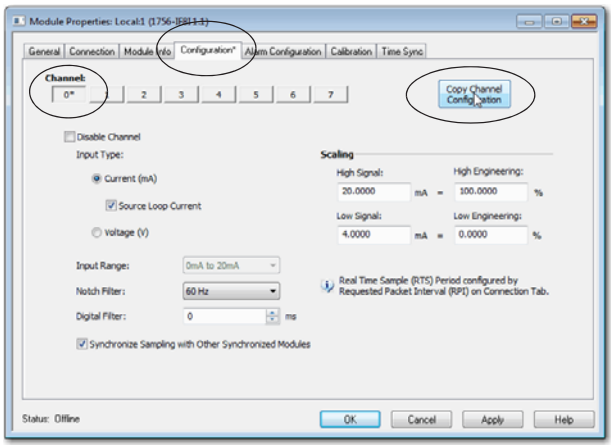
Complete the following steps to copy channel configuration from one channel to others.

1. Verify that your controller is not in Run mode.

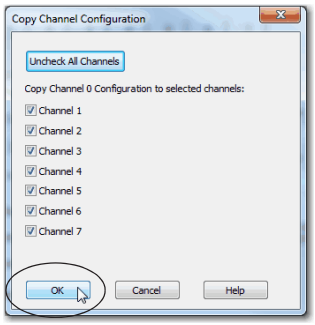
   If so, change it to Remote Run, Remote Program, or Program mode, as applicable to your system.
2. Access the Module Properties dialog box.
3. Click the Configuration tab and make the required configuration changes.

   In this example, the channel 0 configuration for a 1756-IF8I module is copied to all other channels on the module.

4. Click Copy Channel Configuration.



5. Click the channels to which you want to copy channel configuration and click OK.



The configuration is copied to the other channels.

6. Click OK or Apply for the new channel configuration to take effect.

TIP If desired, you can apply configuration changes to the first channel, as described in step 3, before moving to the next step and copying channel configuration.

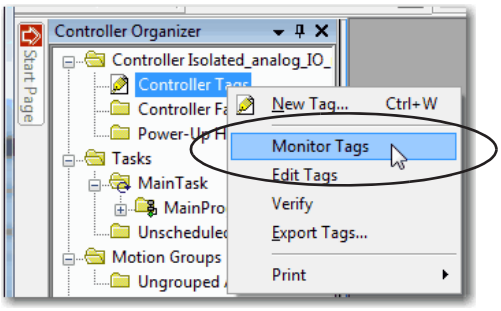
We recommend that you copy channel configuration before applying the changes. In this manner, the controller sends the changes to the module only once and, therefore, needs to make only one connection to the module.

View the Module Tags

When you create a module, the Logix Designer application creates a set of tags that you can view in the Tag Editor. Each configured feature on your module has a distinct tag that is available for use in the controller's programming logic.

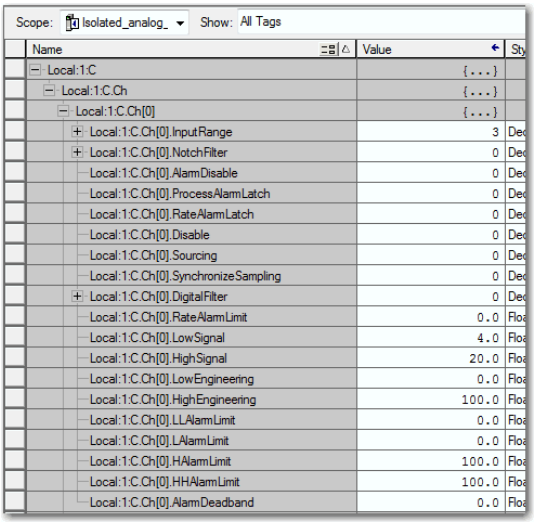
Complete these steps to access a module's tags.

1. In the Controller Organizer, right-click Controller Tags and choose Monitor Tags.



   The Controller Tags dialog box appears with data.

2. Click the + symbols to view module tags as shown in the following graphic.



For more information on module tags, see Appendix A, Isolated Analog I/O Module Tag Definitions on page 173.

Calibrate the ControlLogix Isolated Analog I/O Modules

Topic	Page
Difference between Calibrating an Input Module and an Output Module	138
Calibrate the Input Modules	139
Calibrate the Output Module	152

The ControlLogix isolated analog I/O modules are calibrated during the manufacturing process. Each module's accuracy remains high throughout its lifespan.

IMPORTANT You are **not required** to calibrate the module at any point in its lifespan.
This chapter describes the tasks associated with module calibration if you choose to calibrate the module at any point in their lifespan.

You must add the module to your Logix Designer application project, as described in Chapter 7, before you can calibrate it.

You calibrate isolated analog I/O modules on a channel-by-channel basis or with the channels grouped together.

If you choose to calibrate your module, we recommend the following:

- Calibrate all channels on your module each time you calibrate.

  This maintains consistent calibration readings and improve module accuracy.
- Use an extra 1756-TBCH RTB to calibrate your module.

Difference between Calibrating an Input Module and an Output Module

Although the purpose of calibrating analog modules is the same for input and output modules, to improve the module's accuracy and repeatability, the procedures involved differs for each:

- When you calibrate input modules, you use current, voltage, or ohms reference signals to send a signal to the module to calibrate it.
- When you calibrate output modules, you use a digital multimeter (DMM) to measure the signal the module is sending out.

To maintain your module's factory calibration accuracy, we recommend instrumentation with the specifications listed below. A high resolution DMM can also be used to adjust a voltage/current calibrating source to its value.

Module	Channel Input Type	Recommended Instrument Specifications
1756-IF8I	Current (mA)	1.00…20.00 mA source ±100 nA current
	Voltage (V)	0…10V source ±2 µV voltage
1756-IRT8I	RTD	1.0…487.0 Ω resistors ±0.01%
	Thermocouple (mV)	0…100 mV source ±0.5 µV
1756-OF8I	Current (mA)	DMM with resolution better than 0.15 µA
	Voltage (V)	DMM with resolution better than 1.0 µV

IMPORTANT Do not calibrate your module with an instrument that is less accurate than those recommended. The following events can result:

- Calibration appears to occur normally but the module gives inaccurate data during operation.
- A calibration fault occurs, forcing you to abort calibration.
- The *I.Ch[x].CalibrationFault* tag is set for the channel you attempted to calibrate.

  You can clear the tag by completing a valid calibration or cycling power to the module. In this case, you must recalibrate the module with an instrument as accurate as recommended.

Calibrate in Program Mode

Your project must be online with the controller to calibrate ControlLogix isolated analog I/O modules. You can calibrate in the following conditions:

- The controller in Program mode--either Remote Program or Program mode.

  We **recommend** that your module be in Program mode and not be actively controlling a process when you calibrate it.

IMPORTANT	The module freezes the state of each channel and does not update the controller with new data until after the calibration ends. This could be hazardous if active control were attempted during calibration.

- The controller in Run mode-either Remote Run or Run mode.

  In this case, you must inhibit the connection from the controller to the module being calibrated before beginning the calibration process.

Calibrate the Input Modules

Input calibration is a multi-step process. You apply low and high signal references to the module at different steps in the process.

Topic	Page
Calibrate the 1756-IF8I Module	139
Calibrate the 1756-IRT8I Module	144

Calibrate the 1756-IF8I Module

You can calibrate the 1756-IF8I module for use with the following input types:

- Current (mA)
- Voltage (V)

IMPORTANT	This section shows how to calibrate the 1756-IF8I modules for use with only voltage inputs. The calibration process is generally the same if you calibrate the module for use with current inputs except for the following differences: • You connect a current calibrator to the module. • The low reference signal applied to the module = 4 mA. • The high reference signal applied to the module = 20 mA.

Calibrate the 1756-IF8I Module For Voltage Input Type

During voltage calibration, 0.0V and +10.0V external references are applied to the module's channels. The module records the deviation from these reference values and stores it as calibration constants in the module's firmware.

The internal calibration constants are then used in every subsequent signal conversion to compensate for circuit inaccuracies, including the input amplifier, resistors, and the A/D convertor.

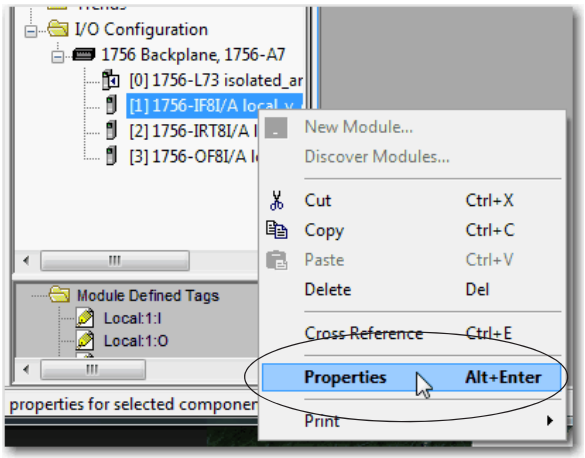
The 1756-IF8I offers three input voltage ranges:

- -10...10V
- 0...5V
- 0...10V

IMPORTANT	Regardless of the input voltage range selected prior to calibration, all voltage calibration uses the -10...10V range.

Follow these steps to calibrate your 1756-IF8I module.

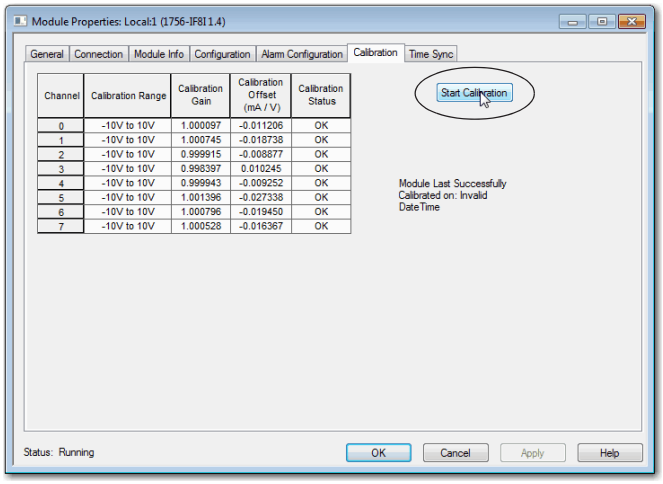
1. Connect your voltage calibrator to all module channels being calibrated.
2. Go online with your project.
3. Right-click the module you want to calibrate and choose Properties.



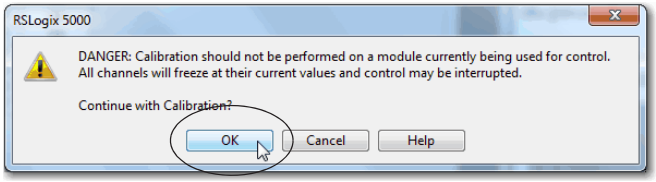
4. On the Configuration tab, make sure the Input Type for each channel to be calibrated is set to Voltage (V).

   The input range selection does not impact calibration.

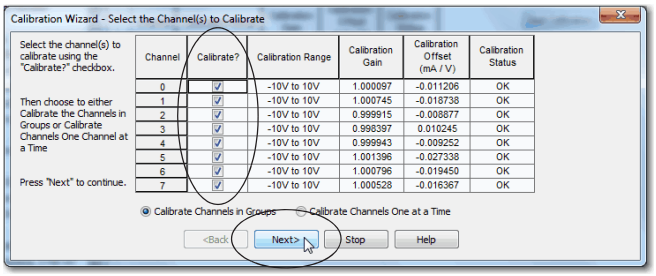
5. On the Calibration tab, click Start Calibration.



6. When the warning appears, click OK.

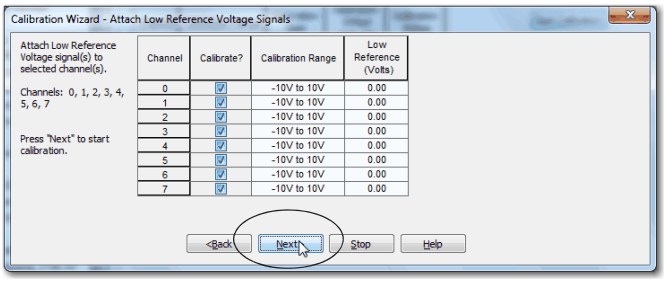

RSLogix 5000
DANGER: Calibration should not be performed on a module currently being used for control.
All channels will freeze at their current values and control may be interrupted.
Continue with Calibration?
OK
Cancel
Help

7. Select the channels to be calibrated and click Next.


Calibration Wizard - Select the Channel(s) to Calibrate
Select the channel(s) to calibrate using the "Calibrate?" checkbox.
Then choose to either Calibrate the Channels in Groups or Calibrate Channels One Channel at a Time
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Calibration Gain
Calibration Offset (mA / V)
Calibration Status
0 -10V to 10V 1.000097 -0.011206 OK
1 -10V to 10V 1.000745 -0.018738 OK
2 -10V to 10V 0.999915 -0.008877 OK
3 -10V to 10V 0.998397 0.010245 OK
4 -10V to 10V 0.999943 -0.009252 OK
5 -10V to 10V 1.001396 -0.027338 OK
6 -10V to 10V 1.000796 -0.019450 OK
7 -10V to 10V 1.000528 -0.016367 OK
Calibrate Channels in Groups
Calibrate Channels One at a Time
<Back
Next>
Stop
Help

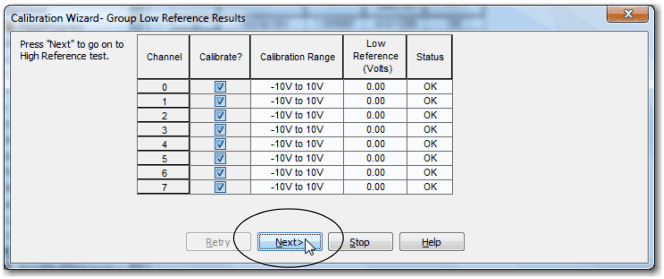
The Attach Low Reference Voltage Signals dialog box appears, as shown below. It indicates the channels are calibrated for a low reference and the range of the calibration.

8. Set the calibrator for the low reference and apply it to the module.
9. Click Next.



The Group Low Reference Results dialog box indicates the status of each channel after calibrating for a low reference.

10. If channels are OK, click Next.

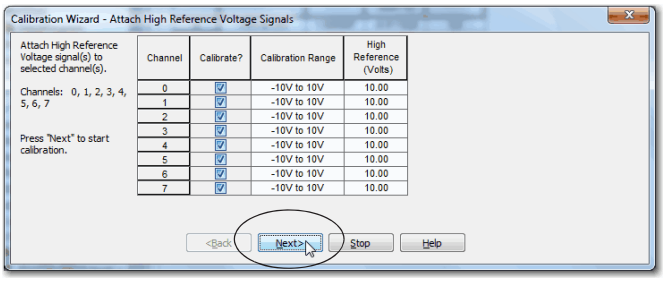


If any channel reports an error, return to step 8 and click Retry until the status is OK.

If the error persists indefinitely, click Stop to exit calibration. The channel remains calibrated to the accuracy level achieved at factory calibration.

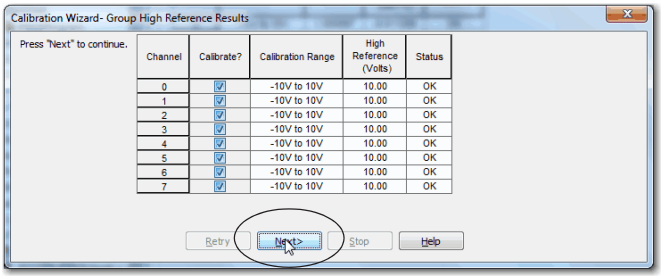
The Attach High Reference Voltage Signals dialog box appears, as shown below. It indicates the channels are calibrated for a high reference and the range of the calibration.

11. Set the calibrator for the high reference voltage and apply it to the module.
12. Click Next.


Calibration Wizard - Attach High Reference Voltage Signals
Attach High Reference Voltage signal(s) to selected channel(s).
Channels: 0, 1, 2, 3, 4, 5, 6, 7
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
High Reference (Volts)
0 -10V to 10V 10.00
1 -10V to 10V 10.00
2 -10V to 10V 10.00
3 -10V to 10V 10.00
4 -10V to 10V 10.00
5 -10V to 10V 10.00
6 -10V to 10V 10.00
7 -10V to 10V 10.00
<Back
Next>
Stop
Help

The Group High Reference Results dialog box indicates the status of each channel after calibrating for a high reference.

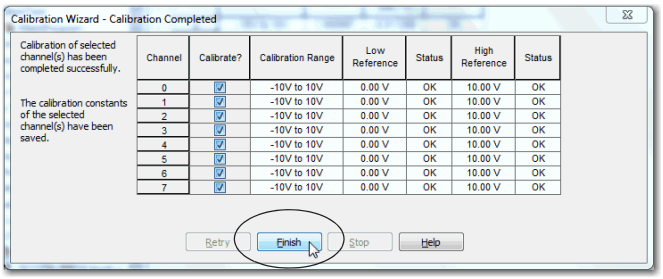
13. If channels are OK, click Next.



If any channel reports an error, return to step 11 and click Retry until the status is OK.

If the error persists indefinitely, click Stop to exit calibration. The channel remains calibrated to the accuracy level achieved at factory calibration.

14. When the Calibration Completed dialog box appears, click Finish.


Calibration Wizard - Calibration Completed
Calibration of selected channel(s) has been completed successfully.
The calibration constants of the selected channel(s) have been saved.
Channel
Calibrate?
Calibration Range
Low Reference
Status
High Reference
Status
0 -10V to 10V 0.00 V OK 10.00 V OK
1 -10V to 10V 0.00 V OK 10.00 V OK
2 -10V to 10V 0.00 V OK 10.00 V OK
3 -10V to 10V 0.00 V OK 10.00 V OK
4 -10V to 10V 0.00 V OK 10.00 V OK
5 -10V to 10V 0.00 V OK 10.00 V OK
6 -10V to 10V 0.00 V OK 10.00 V OK
7 -10V to 10V 0.00 V OK 10.00 V OK
Retry
Finish
Stop
Help

Calibrate the 1756-IRT8I Module

You can calibrate the 1756-IRT8I module for use with the following input types:

- RTD (Ohms) - 3 and 4 Wire types
- Thermocouple (mV)

Calibrate the 1756-IRT8I Module for an RTD Input Type

The 1756-IRT8I uses two precision resistors to calibrate the channels in ohms. You connect the following:

- 1 Ω precision resistor for low reference calibration
- 487 Ω precision resistor for high reference calibration

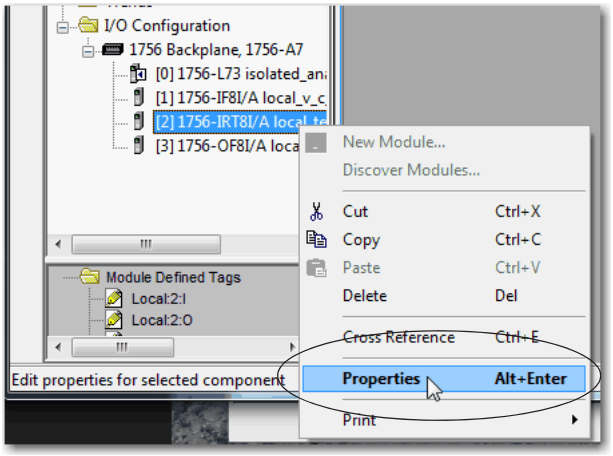
IMPORTANT	After you connect either precision resistors, we recommend that you wait for a minimum of two minutes before proceeding to the next task to obtain the highest calibration accuracy. For more information, see page 146 and page 147.

The 1756-IRT8I module can operate in multiple input ranges when an RTD is connected. However, the module calibrates only in the 1...510 Ω range.

IMPORTANT	When you are wiring precision resistors for calibration, follow the wiring example on page 89. Make sure terminals IN_x(-)/B and IN_x/RTD C are shorted together at the RTB. You can calibrate the module for 3-wire or 4-wire mode. Calibrate in the mode in which the module operates.

Follow these steps to calibrate your module.

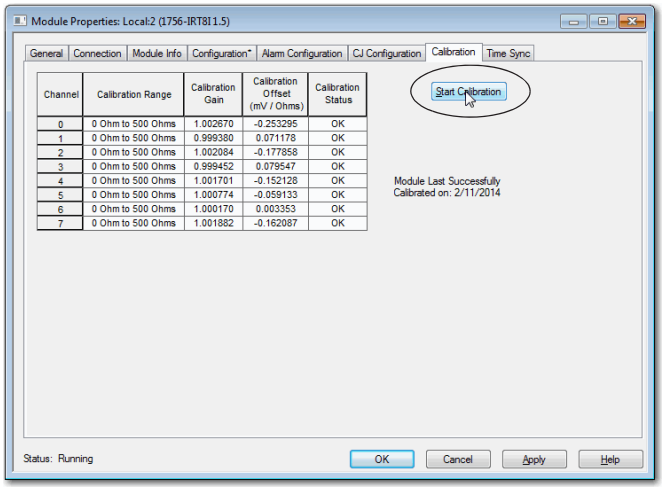
1. Go online with your project.
2. Right-click the module you want to calibrate and choose Properties.



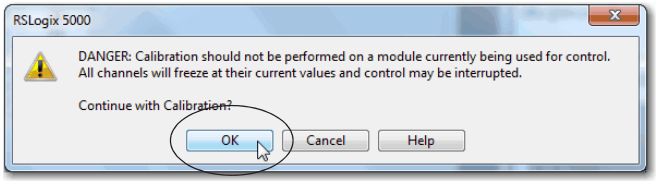
3. On the Configuration tab, make sure the Input Type for each channel to be calibrated is set to the same RTD input type.

   The sensor type selection does not impact calibration.

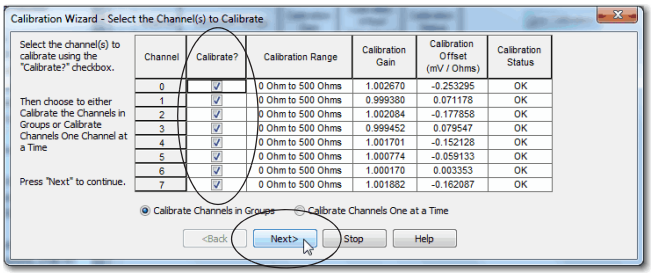
4. On the Calibration tab, click Start Calibration.



5. When the warning appears, click OK.


RSLogix 5000
DANGER: Calibration should not be performed on a module currently being used for control.
All channels will freeze at their current values and control may be interrupted.
Continue with Calibration?
OK
Cancel
Help

6. Select the channels to be calibrated and click Next.

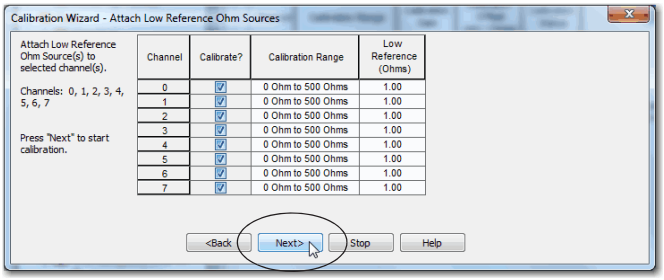

Calibration Wizard - Select the Channel(s) to Calibrate
Select the channel(s) to calibrate using the "Calibrate?" checkbox.
Then choose to either Calibrate the Channels in Groups or Calibrate Channels One Channel at a Time
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Calibration Gain
Calibration Offset (mV / Ohms)
Calibration Status
0 0 Ohm to 500 Ohms 1.002670 -0.253295 OK
1 0 Ohm to 500 Ohms 0.999380 0.071178 OK
2 0 Ohm to 500 Ohms 1.002084 -0.177858 OK
3 0 Ohm to 500 Ohms 0.999452 0.079547 OK
4 0 Ohm to 500 Ohms 1.001701 -0.152128 OK
5 0 Ohm to 500 Ohms 1.000774 -0.059133 OK
6 0 Ohm to 500 Ohms 1.000170 0.003353 OK
7 0 Ohm to 500 Ohms 1.001882 -0.162087 OK
Calibrate Channels in Groups
Calibrate Channels One at a Time
<Back
Next>
Stop
Help

The Attach Low Reference Ohms Sources dialog box appears, as shown below. It indicates the channels are calibrated for a low reference and the range of the calibration.

7. Connect a 1 Ω precision resistor to all module channels being calibrated.

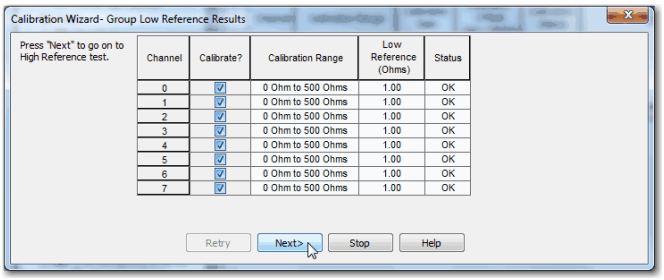
IMPORTANT	After you connect the precision resistor, we recommend that you wait for a minimum of two minutes before proceeding to the next task to obtain the highest calibration accuracy.

8. Click Next.



The Group Low Reference Results dialog box indicates the status of each channel after calibrating for a low reference.

9. If channels are OK, click Next.



If any channel reports an error, return to step 7 and click Retry until the status is OK.

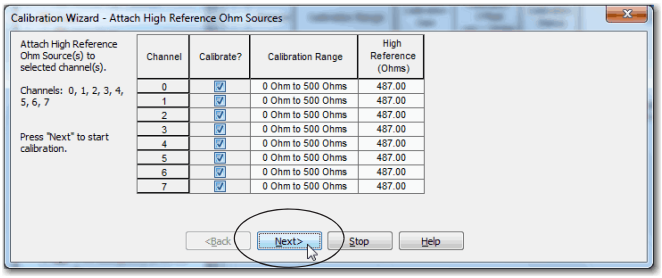
If the error persists indefinitely, click Stop to exit calibration. The channel remains calibrated to the accuracy level achieved at factory calibration.

The Attach High Reference Ohms Sources dialog box appears. It indicates the channels are calibrated for a high reference and the range of the calibration.

10. Connect a 487 Ω precision resistor to all module channels being calibrated.

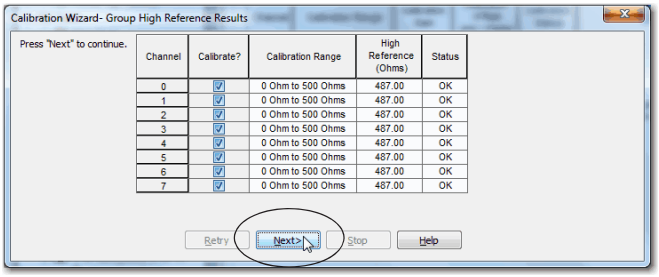
IMPORTANT	After you connect the precision resistor, we recommend that you wait for a minimum of two minutes before proceeding to the next task to obtain the highest calibration accuracy.

11. Click Next.



The Group High Reference Results dialog box indicates the status of each channel after calibrating for a high reference.

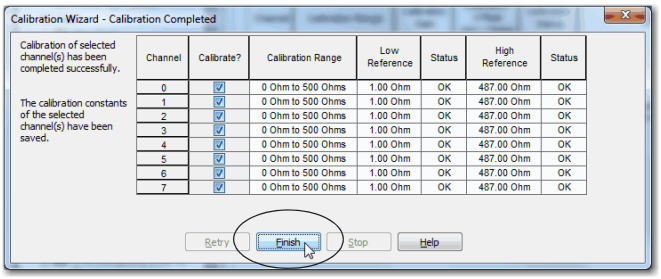
12. If channels are OK, click Next.



If any channel reports an error, return to step 10 and click Retry until the status is OK.

If the error persists indefinitely, click Stop to exit calibration. The channel remains calibrated to the accuracy level achieved at factory calibration.

13. When the Calibration Completed dialog box appears, click Finish.

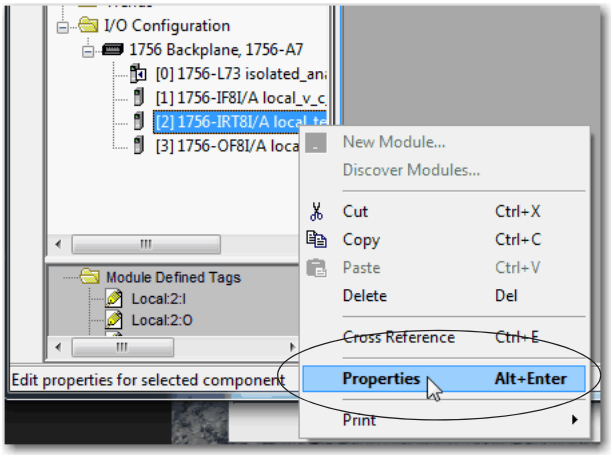


Calibrate the 1756-IRT8I for a Thermocouple Input Type

IMPORTANT Channels configured for Thermocouple inputs perform a wire resistance self-calibration when the module power is cycled.

Follow these steps to calibrate your module.

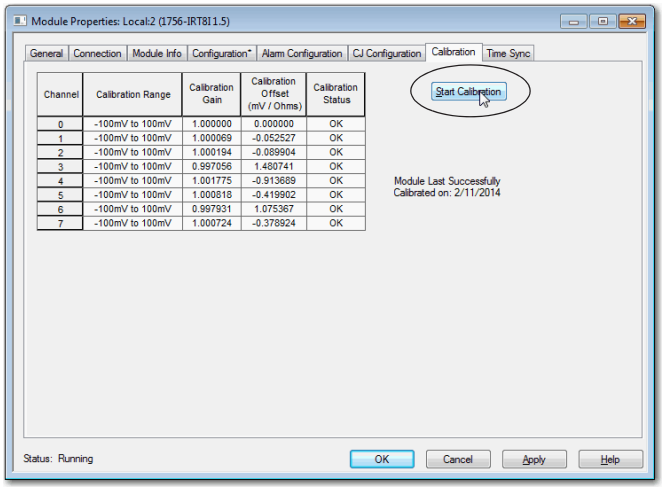
1. Connect your voltage calibrator to all module channels being calibrated.
2. Go online with your project.
3. Right-click the module you want to calibrate and choose Properties.



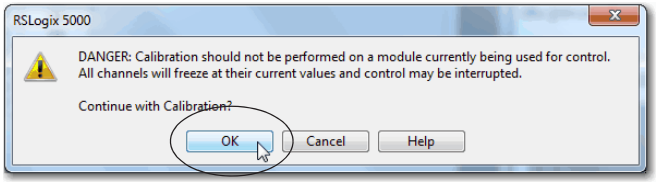
4. On the Configuration tab, make sure the Input Type for each channel to be calibrated is set to Thermocouple (mV).

   The sensor type selection does not impact calibration.

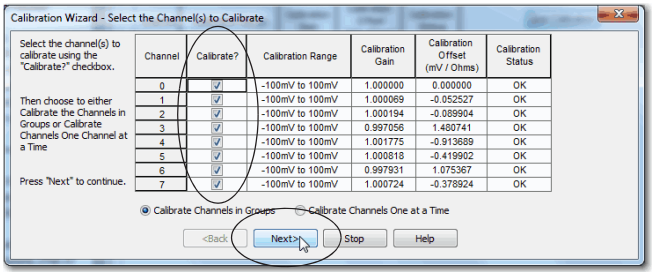
5. On the Calibration tab, click Start Calibration.



6. When the warning appears, click OK.

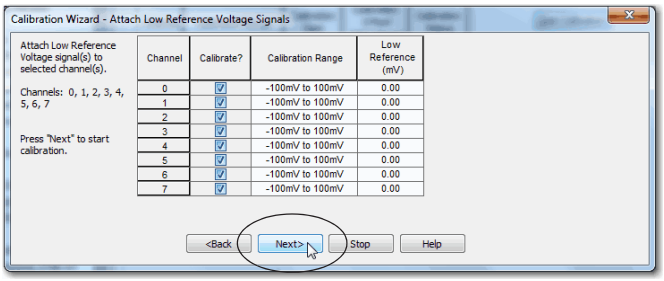

RSLogix 5000
DANGER: Calibration should not be performed on a module currently being used for control.
All channels will freeze at their current values and control may be interrupted.
Continue with Calibration?
OK
Cancel
Help

7. Select the channels to be calibrated and click Next.


Calibration Wizard - Select the Channel(s) to Calibrate
Select the channel(s) to calibrate using the "Calibrate?" checkbox.
Then choose to either Calibrate the Channels in Groups or Calibrate Channels One Channel at a Time
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Calibration Gain
Calibration Offset (mV / Ohms)
Calibration Status
0 -100mV to 100mV 1.000000 0.000000 OK
1 -100mV to 100mV 1.000069 -0.052527 OK
2 -100mV to 100mV 1.000194 -0.089904 OK
3 -100mV to 100mV 0.997056 1.480741 OK
4 -100mV to 100mV 1.001775 -0.913689 OK
5 -100mV to 100mV 1.000818 -0.419902 OK
6 -100mV to 100mV 0.997931 1.075367 OK
7 -100mV to 100mV 1.000724 -0.378924 OK
Calibrate Channels in Groups
Calibrate Channels One at a Time
<Back
Next>
Stop
Help

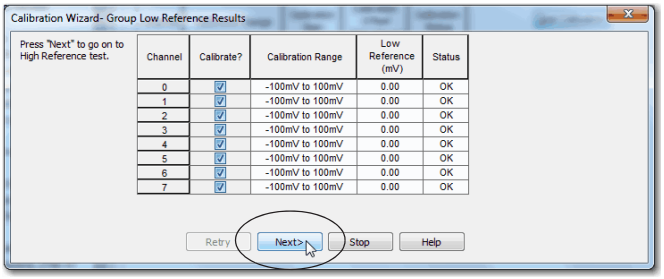
The Attach Low Reference Voltage Signals dialog box appears, as shown below. It indicates the channels are calibrated for a low reference and the range of the calibration.

8. Set the calibrator for the low reference and apply it to the module.
9. Click Next.


Calibration Wizard - Attach Low Reference Voltage Signals
Attach Low Reference Voltage signal(s) to selected channel(s).
Channels: 0, 1, 2, 3, 4, 5, 6, 7
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
Low Reference (mV)
0 -100mV to 100mV 0.00
1 -100mV to 100mV 0.00
2 -100mV to 100mV 0.00
3 -100mV to 100mV 0.00
4 -100mV to 100mV 0.00
5 -100mV to 100mV 0.00
6 -100mV to 100mV 0.00
7 -100mV to 100mV 0.00
<Back
Next>
Stop
Help

The Group Low Reference Results dialog box appears, as shown below. It indicates the status of each channel after calibrating for a low reference.

10. If channels are OK, click Next.

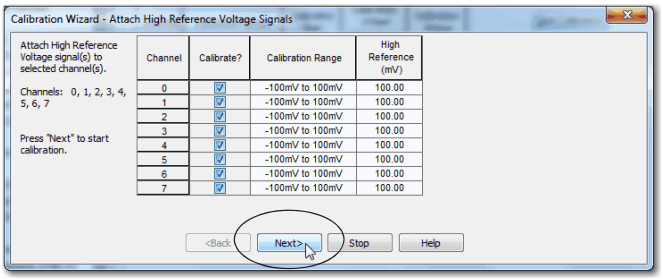


If any channel reports an error, return to step 8 and click Retry until the status is OK.

If the error persists indefinitely, click Stop to exit calibration. The channel remains calibrated to the accuracy level achieved at factory calibration.

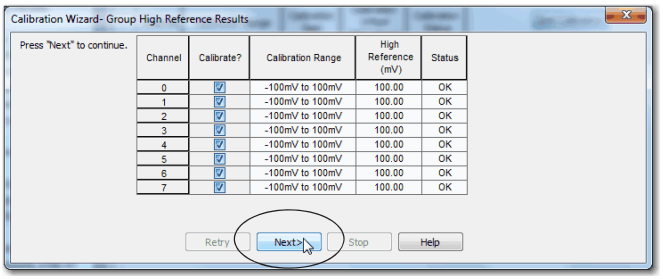
The Attach High Reference Voltage Signals dialog box appears, as shown below. It indicates the channels are calibrated for a high reference and the range of the calibration.

11. Set the calibrator for the high reference voltage and apply it to the module.
12. Click Next.


Calibration Wizard - Attach High Reference Voltage Signals
Attach High Reference Voltage signal(s) to selected channel(s).
Channels: 0, 1, 2, 3, 4, 5, 6, 7
Press "Next" to start calibration.
Channel
Calibrate?
Calibration Range
High Reference (mV)
0 -100mV to 100mV 100.00
1 -100mV to 100mV 100.00
2 -100mV to 100mV 100.00
3 -100mV to 100mV 100.00
4 -100mV to 100mV 100.00
5 -100mV to 100mV 100.00
6 -100mV to 100mV 100.00
7 -100mV to 100mV 100.00
<Back
Next>
Stop
Help

The Group High Reference Results dialog box indicates the status of each channel after calibrating for a high reference.

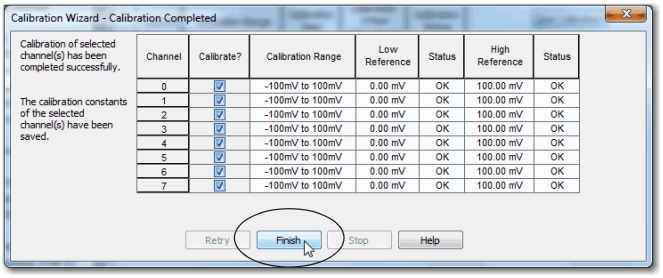
13. If channels are OK, click Next.



If any channel reports an error, return to step 11 and click Retry until the status is OK.

If the error persists indefinitely, click Stop to exit calibration. The channel remains calibrated to the accuracy level achieved at factory calibration.

14. When the Calibration Completed dialog box appears, click Finish.


Calibration Wizard - Calibration Completed
Calibration of selected channel(s) has been completed successfully.
The calibration constants of the selected channel(s) have been saved.
Channel
Calibrate?
Calibration Range
Low Reference
Status
High Reference
Status
0 -100mV to 100mV 0.00 mV OK 100.00 mV OK
1 -100mV to 100mV 0.00 mV OK 100.00 mV OK
2 -100mV to 100mV 0.00 mV OK 100.00 mV OK
3 -100mV to 100mV 0.00 mV OK 100.00 mV OK
4 -100mV to 100mV 0.00 mV OK 100.00 mV OK
5 -100mV to 100mV 0.00 mV OK 100.00 mV OK
6 -100mV to 100mV 0.00 mV OK 100.00 mV OK
7 -100mV to 100mV 0.00 mV OK 100.00 mV OK
Retry
Finish
Stop
Help

Calibrate the Output Module

You can calibrate the 1756-OF8I module for use with the following output types:

- Current (mA)
- Voltage (V)

IMPORTANT This section shows how to calibrate the 1756-OF8I modules for use with only current outputs.

The calibration process is generally the same if you calibrate the module for use with voltage inputs except for the following differences:

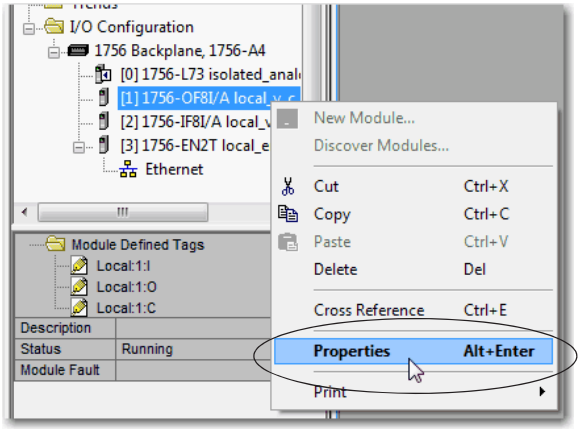
- You connect a voltage meter to the module.
- The low reference signal measured at the module is in volts.
- The high reference signal measured at the module is in volts.

Calibrate the 1756-OF8I Module for a Current Output Type

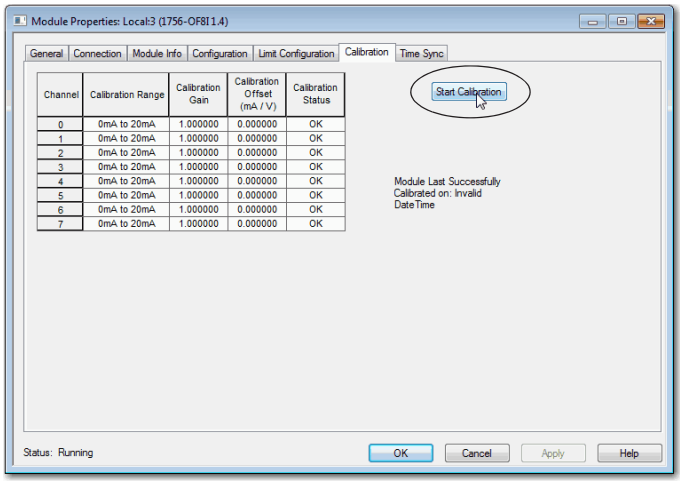
When calibrating an output channel for use with a current output type, the Logix Designer application commands the module to output specific levels of current. You must measure the actual level and record the results to account for any module inaccuracies.

Follow these steps to calibrate your module.

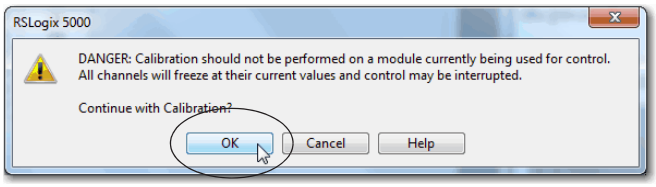
1. Connect your current meter to all module channels being calibrated.
2. Go online with your project.
3. Right-click the module you want to calibrate and choose Properties.



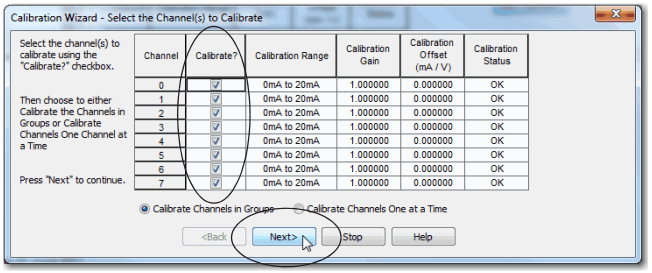
4. On the Configuration tab, make sure the Output Type for each channel to be calibrated is set to Current (mA).
5. On the Calibration tab, click Start Calibration.



6. When the warning appears, click OK.

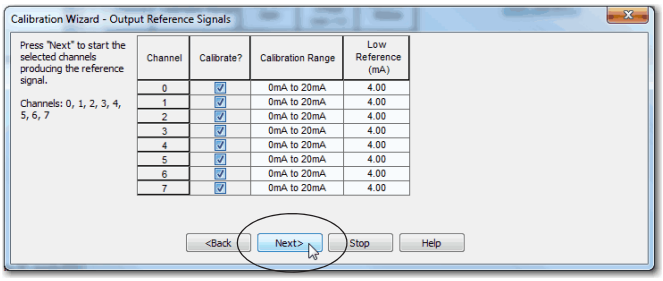

RSLogix 5000
DANGER: Calibration should not be performed on a module currently being used for control.
All channels will freeze at their current values and control may be interrupted.
Continue with Calibration?
OK
Cancel
Help

7. Select the channels to be calibrated and click Next.


Calibration Wizard - Select the Channel(s) to Calibrate
Select the channel(s) to calibrate using the "Calibrate?" checkbox.
Then choose to either Calibrate the Channels in Groups or Calibrate Channels One Channel at a Time
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Calibration Gain
Calibration Offset (mA / V)
Calibration Status
0 0mA to 20mA 1.000000 0.000000 OK
1 0mA to 20mA 1.000000 0.000000 OK
2 0mA to 20mA 1.000000 0.000000 OK
3 0mA to 20mA 1.000000 0.000000 OK
4 0mA to 20mA 1.000000 0.000000 OK
5 0mA to 20mA 1.000000 0.000000 OK
6 0mA to 20mA 1.000000 0.000000 OK
7 0mA to 20mA 1.000000 0.000000 OK
Calibrate Channels in Groups
Calibrate Channels One at a Time
<Back
Next>
Stop
Help

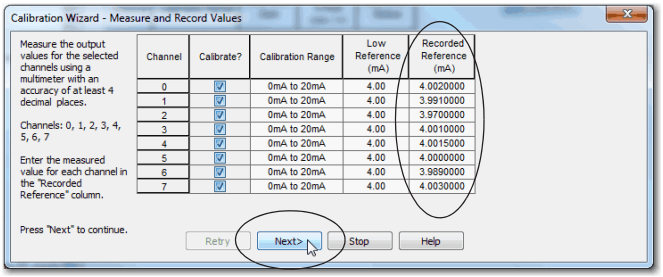
The Output Reference Signals dialog box appears. It indicates the channels are calibrated for a low reference and the calibration range.

8. Click Next.


Calibration Wizard - Output Reference Signals
Press "Next" to start the selected channels producing the reference signal.
Channels: 0, 1, 2, 3, 4, 5, 6, 7
Channel
Calibrate?
Calibration Range
Low Reference (mA)
0 0mA to 20mA 4.00
1 0mA to 20mA 4.00
2 0mA to 20mA 4.00
3 0mA to 20mA 4.00
4 0mA to 20mA 4.00
5 0mA to 20mA 4.00
6 0mA to 20mA 4.00
7 0mA to 20mA 4.00
<Back
Next>
Stop
Help

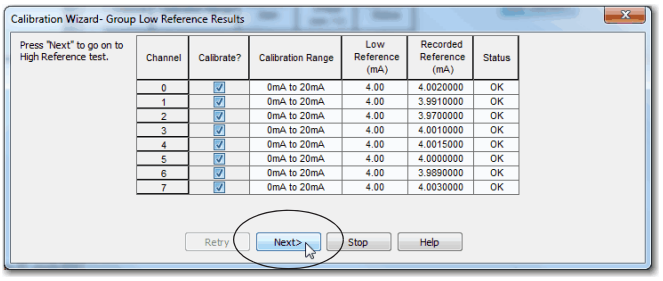
The Measure and Record Values dialog box appears.

9. For each channel being calibrated, use your current meter to measure the reference value of each channel individually.
10. In the Recorded Reference (mA) column record the measured value for each channel that was recorded and click Next.


Calibration Wizard - Measure and Record Values
Measure the output values for the selected channels using a multimeter with an accuracy of at least 4 decimal places.
Channels: 0, 1, 2, 3, 4, 5, 6, 7
Enter the measured value for each channel in the "Recorded Reference" column.
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
Low Reference (mA)
Recorded Reference (mA)
0 0mA to 20mA 4.00 4.0020000
1 0mA to 20mA 4.00 3.9910000
2 0mA to 20mA 4.00 3.9700000
3 0mA to 20mA 4.00 4.0010000
4 0mA to 20mA 4.00 4.0015000
5 0mA to 20mA 4.00 4.0000000
6 0mA to 20mA 4.00 3.9890000
7 0mA to 20mA 4.00 4.0030000
Retry
Next>
Stop
Help

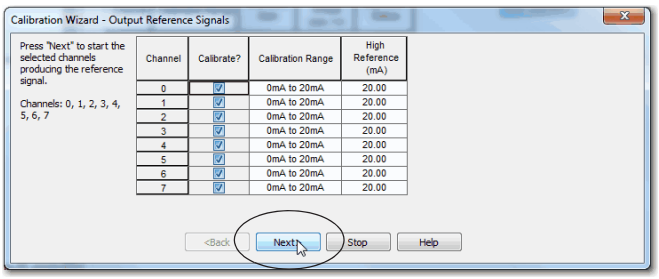
The Group Low Reference Results dialog box indicates the status of each channel. If the status is not OK for any channels, repeat the calibration process.

11. Click Next.


Calibration Wizard- Group Low Reference Results
Press "Next" to go on to High Reference test.
Channel
Calibrate?
Calibration Range
Low Reference (mA)
Recorded Reference (mA)
Status
0 0mA to 20mA 4.00 4.0020000 OK
1 0mA to 20mA 4.00 3.9910000 OK
2 0mA to 20mA 4.00 3.9700000 OK
3 0mA to 20mA 4.00 4.0010000 OK
4 0mA to 20mA 4.00 4.0015000 OK
5 0mA to 20mA 4.00 4.0000000 OK
6 0mA to 20mA 4.00 3.9890000 OK
7 0mA to 20mA 4.00 4.0030000 OK
Retry
Next>
Stop
Help

The Output Reference Signals dialog box appears, as shown below. It indicates the channels are calibrated for a high reference and the calibration range.

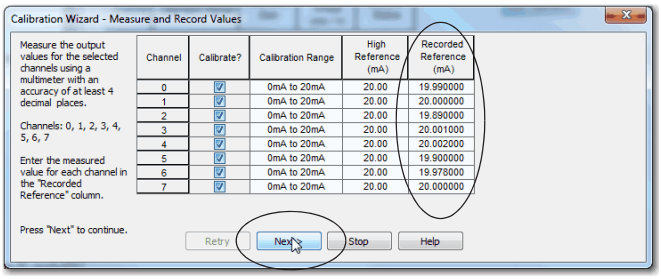
12. Click Next.


Calibration Wizard - Output Reference Signals
Press "Next" to start the selected channels producing the reference signal.
Channels: 0, 1, 2, 3, 4, 5, 6, 7
Channel
Calibrate?
Calibration Range
High Reference (mA)
0 0mA to 20mA 20.00
1 0mA to 20mA 20.00
2 0mA to 20mA 20.00
3 0mA to 20mA 20.00
4 0mA to 20mA 20.00
5 0mA to 20mA 20.00
6 0mA to 20mA 20.00
7 0mA to 20mA 20.00
<Back
Next>
Stop
Help

The Measure and Record Values dialog box appears.

13. For each channel being calibrated, use your current meter to measure the reference value of each channel individually.

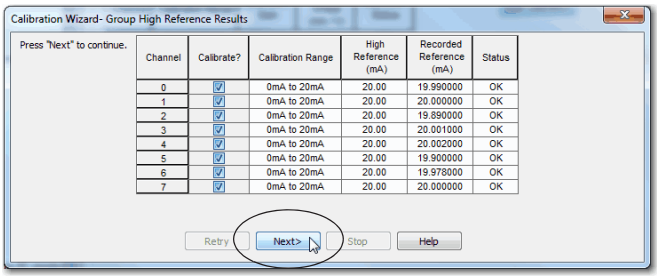
14. In the Recorded Reference (mA) column record the measured value for each channel that was recorded and click Next.


Calibration Wizard - Measure and Record Values
Measure the output values for the selected channels using a multimeter with an accuracy of at least 4 decimal places.
Channels: 0, 1, 2, 3, 4, 5, 6, 7
Enter the measured value for each channel in the "Recorded Reference" column.
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
High Reference (mA)
Recorded Reference (mA)
0 0mA to 20mA 20.00 19.990000
1 0mA to 20mA 20.00 20.000000
2 0mA to 20mA 20.00 19.890000
3 0mA to 20mA 20.00 20.001000
4 0mA to 20mA 20.00 20.002000
5 0mA to 20mA 20.00 19.900000
6 0mA to 20mA 20.00 19.978000
7 0mA to 20mA 20.00 20.000000
Retry
Next>
Stop
Help

The Group High Reference Results dialog box indicates the status of each channel. If the status is not OK for any channels, repeat the calibration process.

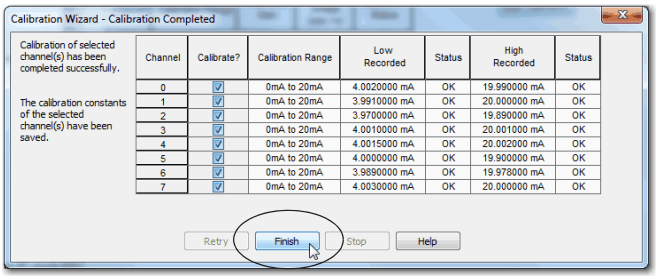
If the error persists indefinitely, click Stop to exit calibration. The channel remains calibrated to the accuracy level achieved at factory calibration.

15. Click Next.


Calibration Wizard- Group High Reference Results
Press "Next" to continue.
Channel
Calibrate?
Calibration Range
High Reference (mA)
Recorded Reference (mA)
Status
0 0mA to 20mA 20.00 19.990000 OK
1 0mA to 20mA 20.00 20.000000 OK
2 0mA to 20mA 20.00 19.890000 OK
3 0mA to 20mA 20.00 20.001000 OK
4 0mA to 20mA 20.00 20.002000 OK
5 0mA to 20mA 20.00 19.900000 OK
6 0mA to 20mA 20.00 19.978000 OK
7 0mA to 20mA 20.00 20.000000 OK
Retry
Next>
Stop
Help

The Calibration Completed dialog box indicates the status of each channel.

16. Click Finish.


Calibration Wizard - Calibration Completed
Calibration of selected channel(s) has been completed successfully.
The calibration constants of the selected channel(s) have been saved.
Channel
Calibrate?
Calibration Range
Low Recorded
Status
High Recorded
Status
0 0mA to 20mA 4.0020000 mA OK 19.990000 mA OK
1 0mA to 20mA 3.9910000 mA OK 20.000000 mA OK
2 0mA to 20mA 3.9700000 mA OK 19.890000 mA OK
3 0mA to 20mA 4.0010000 mA OK 20.001000 mA OK
4 0mA to 20mA 4.0015000 mA OK 20.002000 mA OK
5 0mA to 20mA 4.0000000 mA OK 19.900000 mA OK
6 0mA to 20mA 3.9890000 mA OK 19.978000 mA OK
7 0mA to 20mA 4.0030000 mA OK 20.000000 mA OK
Retry
Finish
Stop
Help

Troubleshoot Your Module

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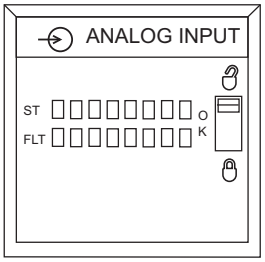
ControlLogix isolated analog I/O module have status indicators on the front of the module that are used to monitor module operation.

Status Indicators for the 1756-IF8I Module

The following graphic shows the status indicators used with 1756-IF8I modules.



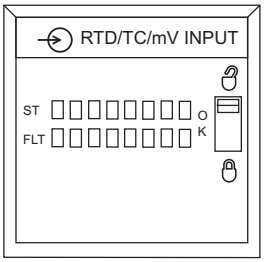
The following table describes the status indicators.

Indicator	Status	Description
OK	Steady green	The module is in a normal operating state in Run mode.
	Flashing green	The module passed internal diagnostics and is not actively controlled or the connection is open and the controller is in Program mode.
	Flashing red	Previously established communication has timed out.
	Steady red	Replace the module.
ST	Steady yellow	The channel is operating as expected.
	Flashing yellow	The channel is being calibrated.
	Off	The channel is not in use or is faulted.

FLT	Off	The channel is operating as expected.
	Steady red	• The channel is faulted.Possible causes of the fault include: – Underrange/overrange detection – Triggered process alarm – Triggered rate alarm – Wire off detection – Calibration fault For more information on these causes see Chapter 3, 1756-IF8I Isolated Analog Input Module on page 45
	Flashing red	One of the following: • The channel is faulted. See the previous row for more information about faults. • The channel is being calibrated.

Status Indicators for the 1756-IRT8I Module

The following graphic shows the status indicators used with 1756-IRT8I module.

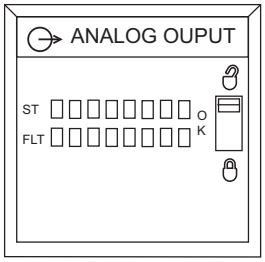


The following table describes the status indicators.

Indicator	Status	Description
OK	Steady green	The module is in a normal operating state in Run mode.
	Flashing green	The module passed internal diagnostics and is not actively controlled or the connection is open and the controller is in Program mode.
	Flashing red	Previously established communication has timed out.
	Steady red	Replace the module.
ST	Steady yellow	The channel is operating as expected.
	Flashing yellow	The channel is being calibrated.
	Off	The channel is not in use or is faulted.
FLT	Off	The channel is operating as expected.
	Steady red	• The channel is faulted. Some possible causes of the fault include: – Underrange/overrange detection – Wire off detection – Calibration fault For more information on these causes see Chapter 4, 1756-IRT8I Combined Temperature-sensing Isolated Analog Module on page 65
	Flashing red	One of the following: • The channel is faulted. See the previous row for more information about faults. • The channel is being calibrated.

Status Indicators for the 1756-OF8I Module

The following graphic shows the status indicators used with 1756-OF8I module.



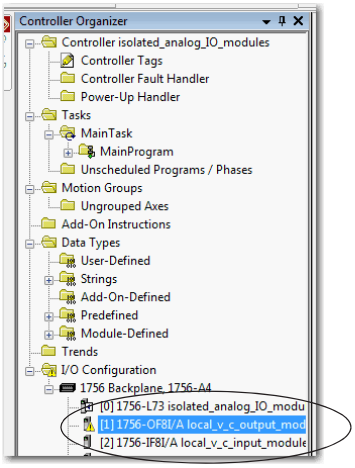
The following table describes the status indicators.

Indicator	Status	Description
OK	Steady green	The module is in a normal operating state in Run mode.
	Flashing green	The module passed internal diagnostics and is not actively controlled or the connection is open and the controller is in Program mode.
	Flashing red	Previously established communication has timed out.
	Steady red	Replace the module.
ST	Steady yellow	The channel is operating as expected.
	Flashing yellow	The channel is being calibrated.
	Off	The channel is not in use or is faulted.
FLT	Off	The channel is operating as expected.
	Steady red	• The channel is faulted. Some possible causes of the fault include: – Triggered clamp alarm – Wire off detection – Calibration fault For more information on these causes see Chapter 5, 1756-OF8I Isolated Analog Output Module on page 93
	Flashing red	The channel is faulted. See the previous row for more information about faults.

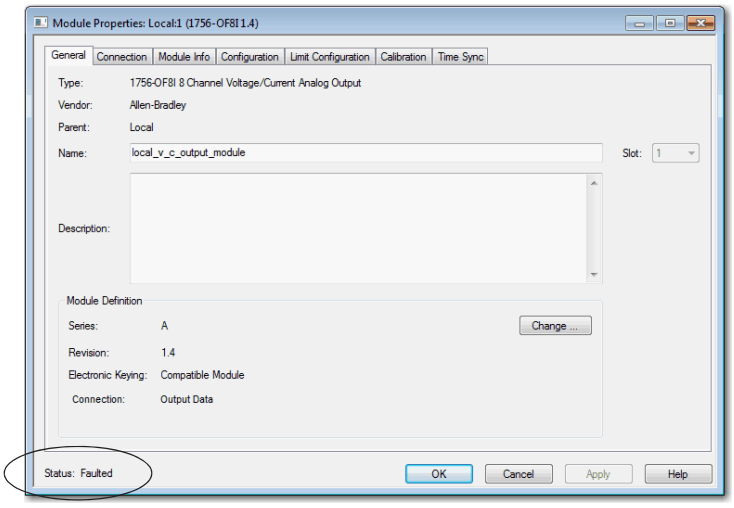
Use Logix Designer Application for Troubleshooting

The Logix Designer application indicates fault conditions in the following ways:

- **Warning signal** on the main screen next to the module - This occurs when the connection to the module is broken.



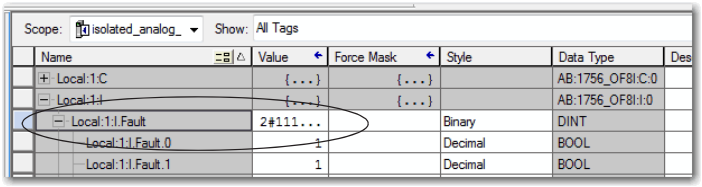
- Message in a screen's **status line**



On the Module Info tab, in the Status section, the Major and Minor Faults are listed along with the Internal State of the module.

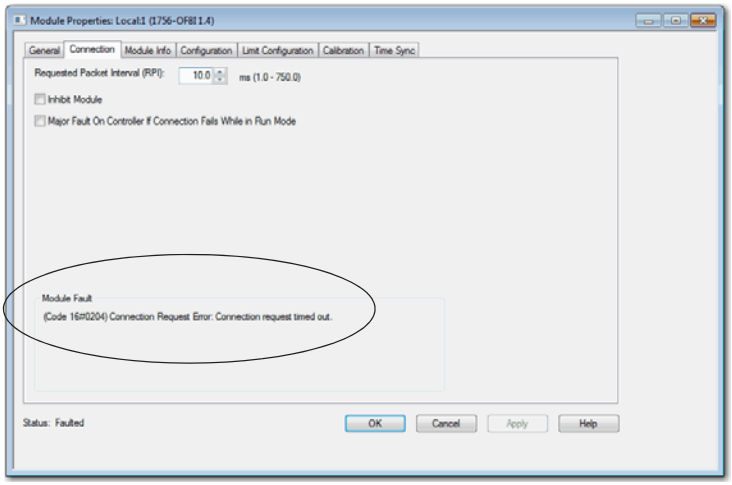
- **Notification in the Tag Editor** - General module faults are also reported in the Tag Editor. Diagnostic faults are reported only in the Tag Editor.

  The Value field indicates a fault with the number 1.



Fault Type Determination

When you are monitoring a module's configuration properties in the Logix Designer application and receive a Communication fault message, the Connection tab indicates the type of fault under Module Fault.



Troubleshoot Incorrect Readings on the Module

Incorrect temperature, current or voltage readings on temperature-sensing and current/voltage I/O modules are often considered to be the result of a module needing to be calibrated. This is typically not the case.

ControlLogix isolated analog I/O modules are calibrated before shipment from the factory and maintain a high degree of module accuracy throughout their lifespan. Additionally, 1756-IRT8I module channels configured for Thermocouple inputs perform a resistance self-calibration when the module power is cycled.

The following sections describe tasks you can use to troubleshoot your module:

- 1756-IRT8I Module - Incorrect Temperature Readings
- 1756-IRT8I Module - Incorrect RTD Readings
- 1756-IF8I Module - Incorrect Input Voltage/Current Readings
- 1756-OF8I Module - Incorrect Output Voltage/Current Readings

1756-IRT8I Module - Incorrect Temperature Readings

To determine the cause of the incorrect reading, first determine the nature of the incorrect reading. For example, the module can perform as follows:

- The module always reads maximum.
- The module always reads minimum.
- The module reads erratically (data jumping around).
- The module reads with an offset over the entire range.

First, complete the following tasks.

1. Check the status indicators to verify that the module is powered and communicating.

   Red or flashing green status indicators indicate a problem. For more information on the 1756-IRT8I module status indicators, page 158.

2. Check the module wiring to verify the following:
   - The wiring is correct.
   - The wiring is intact.
   - The CJC sensors, if being used, are installed correctly.

IMPORTANT	Remember, if you choose to use CJC sensors with the 1756-IRT8I module, you must use the sensors at both connection positions, that is, the top and bottom of the module. You cannot use only one CJC sensor with the module. For more information on using CJC sensors with the 1756-IRT8I module, see Cold Junction Compensation on page 82.

3. If the status indicators indicate that the module is communicating as expected and all module wiring is correct, complete the following tasks.
   a. Disconnect the thermocouple from the channel in question.
   b. Connect a thermocouple emulator directly to the channel in question.

      The emulator provides voltage at the channel that is equivalent to the voltage expected for the thermocouple type it is emulating.
   - If the emulator temperature report is correct, the module is performing as expected. In this case, the thermocouple and wiring are likely the cause and should be checked again.
   - If the emulator temperature report is incorrect, the module hardware, configuration, or the software application are likely the cause. In this case, check the Logix Designer application project.

   We **highly recommend** using a thermocouple emulator for initial troubleshooting. In lieu of an emulator, you can apply a millivolt signal to the input. The module must be configured to read a millivolt signal. If the module is reading back the millivolt correctly, then the module is performing as expected.

If the previously listed tasks fail to resolve your issue with incorrect temperature readings on your module, use the following table.

Table 16 - 1756-IRT8I Module - Troubleshoot Incorrect Temperature Readings

Possible Cause of Incorrect Reading	Description	Recommended Action
Open circuit	A thermocouple reading maximum (upscale) usually means that there is an open circuit condition. The module indicates this condition through the following: • The FLT status indicator for the channel becomes steady red. • The *I.Ch[x].Overrange* tag is set to 1. *x* represents the channel number. • If the **sensor type is Temperature**, input data from the channel changes to the highest scaled temperature value associated with the sensor type. • If the **sensor type is mV**, the input data for the channel changes to the scaled value associated with the overrange signal value.	One of the following: • Check the wiring, terminations, and for an open thermocouple. • Make sure the length of the thermocouple cable is within module specifications. Wire length that is too long has a higher impedance, and can be interpreted as an open circuit.
Short-circuited input	Thermocouple reading 0 mV can mean that there is a short-circuited input. In some applications, the thermocouple reading 0 mV is correct.	Check wiring and correct terminations.
Electrical noise	Erratic readings, that is, data fluctuating more than is typical, are a product of noise. An oscilloscope shows the magnitude of noise.	• Disconnect all but one thermocouple to see if channels are affecting each other, that is, there is bleed-over. • Eliminate or suppress the effect of noise. Employ hardware or software filters provided by the 1756-IRT8I module, such as the Notch Filter.
DC signal on top of the thermocouple signal	Offset readings can be caused by a DC signal riding on top of the thermocouple signal. An oscilloscope shows the magnitude of the offset.	Disconnect all but one thermocouple to see if channels are affecting each other, that is, there is bleed-over.
Module is in calibration mode	Incorrect readings can be a result of the module being calibrated when the reading occurs.	Make sure the module is not in calibration mode. This symptom is module dependant, but in general, specific bits have to be turned on to enable calibration.
Temperature reading difference between maximum and minimum temperatures	All input channels on a 1756-IRT8I module can use the same configuration and measure the same ambient temperature. A temperature reading difference between upper and lower channels up to -13.33…-12.22 °C (8…10 °F). can cause incorrect readings.	To improve the temperature reading, we recommend that you select remote cold junction compensation and wire to a 1492-AIFM8TC-3 IFM module.
CJC sensor is defective or installed incorrectly	Offset readings can be a result of a defective CJS or incorrect CJS properly.	Check the module input data for a CJC sensor defective diagnostic bit. Thermocouples also report back ambient temperature and provide an accurate ambient temperature if the CJC sensor is healthy, wired properly, and the module is operating within specifications.
Incorrect reading soon after module installation	One of the following: • Incorrect readings at initial module installation and configuration are often the result of installation and configuration errors. • Incorrect readings at installation of an existing, previously-working module are more likely the result of a hardware failure.	One of the following: • If error is occurring on a new module installation and configuration, make sure those tasks were completed corrected and correct any errors you find. • If the error is occurring on an existing, previously-working module, diagnose the hardware failure and correct it. If more than one channel is experiencing the incorrect readings in this case, disconnect all thermocouples except one. This can help determine if it is external hardware or the module itself is the cause.

1756-IRT8I Module - Incorrect RTD Readings

To determine the cause of the incorrect reading, first determine the nature of the incorrect reading. For example, the module can perform as follows:

- The module always reads maximum.
- The module always reads minimum.
- The module reads erratically (data jumping around).
- The module reads with an offset over the entire range.

First, complete the following tasks.

1. Check the status indicators to verify that the module is powered and communicating.

   Red or flashing green status indicators indicate a problem. For more information on the 1756-IRT8I module status indicators, page 158.

2. Make sure wiring is intact and correct.
3. If the status indicators indicate that the module is communicating as expected and all module wiring is correct, complete the following tasks.
   a. Disconnect the RTD from the channel in question.
   b. Connect an RTD emulator directly to the channel in question.

      The emulator provides voltage at the channel that is equivalent to the voltage expected for the RTD type it is emulating.

   – If the ohms value reports back correctly then the module is performing as expected. In this case, the RTD and wiring are likely the cause and should be checked again.
   – If the ohms value reports back incorrectly, the module hardware, configuration, or the software application are likely the cause. In this case, check the Logix Designer application project.

   We **highly recommend** using an RTD emulator for initial troubleshooting. In lieu of an emulator, you can apply a known ohms value to the input. The module must be configured to read an ohms value. If the module is reading back the ohms correctly, then the module is performing as expected.

If the previously listed tasks fail to resolve your issue with incorrect RTD readings on your module, use the following table.

Table 17 - 1756-IRT8I Module - Troubleshoot Incorrect RTD Readings

Possible Cause of Incorrect Reading	Description		Recommended Action
Wire Off	When using a **3-wire RTD** device and any of the following: • One wire is disconnected from any of the channel's terminals. • Wires are disconnected from any combination of terminals: – IN_*x*(+)/A – IN_*x*(-)/B – IN_*x*/RTD C • All of the wires are disconnected from the channel.	The following occurs: • Input data for the channel changes to the highest scaled temperature value associated with the selected sensor type. • The *I.Ch[x].Overrange* tag is set to 1. *x* represents the channel number.	• Check the wiring, terminations, and for an open wire. • Make sure the length of the RTD cable is within module specifications. Wire length that is too long has a higher impedance, and can be interpreted as an open circuit.
	When using a **4-wire RTD** device and any of the following: • A wire is disconnected from only terminal IN_*x*(-)/B. • Wires are disconnected from any combination of the channel's terminals, that is: – IN_*x*(+)/A – IN_*x*(-)/B – IN_*x*/RTD C – IN_*x*/RTD D **IMPORTANT**: There is one combination exception that does not apply. A wire off condition is not detected when wires are simultaneously disconnected from only IN_*x*/RTD C and IN_*x*/RTD D terminals. • All wires are disconnected from the module.	If bullet 1, the following occurs: • Input data for the channel changes to the lowest scaled temperature value associated with the selected sensor type. • The *I.Ch[x].Underrange* tag is set to 1. *x* represents the channel number. If bullets 2 or 3, the following occurs: • Input data for the channel changes to the highest scaled temperature value associated with the selected sensor type. • The *I.Ch[x].Overrange* tag is set to 1. *x* represents the channel number.	

Table 17 - 1756-IRT8I Module - Troubleshoot Incorrect RTD Readings

Possible Cause of Incorrect Reading	Description	Recommended Action
Electrical noise	Erratic readings, that is, data fluctuating more than is typical, are a cause of noise. An oscilloscope shows the magnitude of noise.	• Disconnect all but one RTD to see if channels are affecting each other, that is, there is bleed-over. • Eliminate or suppress the effect of noise. Employ hardware or software filters provided by the 1756-IRT8I module, such as the Notch Filter.
DC signal on top of the thermocouple signal	Offset readings can be caused by a DC signal riding on top of the thermocouple signal. An oscilloscope shows the magnitude of the offset.	Disconnect all but one RTD to see if channels are affecting each other, that is, there is bleed-over.
Module is in calibration mode	Incorrect readings can be a result of the module being calibrated when the reading occurs.	Make sure the module is not in calibration mode. This symptom is module dependent, but in general, specific bits have to be turned on to enable calibration.
Incorrect reading soon after module installation	One of the following: • Incorrect readings at initial module installation and configuration are often the result of installation and configuration errors. • Incorrect readings at installation of an existing, previously-working module are more likely the result of a hardware failure.	One of the following: • If error is occurring on a new module installation and configuration, make sure that those tasks were completed corrected and correct any errors you find. • If the error is occurring on an existing, previously-working module, diagnose the hardware failure and correct it. If more than one channel is experiencing the incorrect readings in this case, disconnect all thermocouples except one. This can help determine if it is external hardware or the module itself is the cause
Grounded RTD	Due to the module's excitation current traveling on an RTD lead that is grounded there can be errant ground paths which would cause inaccuracies to the RTD measurements.	Eliminate the ground or use a signal conditioner/isolator.
Lead Compensation	An RTD sensor requires at least 3 leads to compensate for lead resistance error, caused by resistance mismatch. The amount of error eliminated depends upon the difference between the resistance values of the lead wires. The closer the resistance values are to each other, the greater the amount of error that is eliminated	To verify that the lead resistance values match as closely as possible: • use heavy gauge wire (16–18 gauge) • keep lead distances less than 1000 feet • use quality cable that has a small tolerance impedance rating.
Sensor Offset	The software configured Sensor Offset value is summed with the input data value.	Verify that the Sensor Offset feature is desired.
Programming and Configuration	One of the following: • Input value read from correct data tag. • Channel configured for correct range. • Signal and Engineering units are set correctly and equal.	If the incorrect input data value is in a secondary location, for example, an HMI device, verify the base tag value in the controller. Correct module configuration as needed.

1756-IF8I Module - Incorrect Input Voltage/Current Readings

To determine the cause of the incorrect reading, first determine the nature of the incorrect reading. For example, the module can perform as follows:

- The module always reads maximum.
- The module always reads minimum/zero/negative.
- The module reads voltage/current erratically (data jumping around).
- The module reads with an offset over the entire range.

First, complete the following tasks.

1. Check the status indicators to verify that the module is powered and communicating.

   Red or flashing green status indicators indicate a problem. For more information on the 1756-IF8I module status indicators, page 157.

2. Make sure wiring is intact and correct, current or voltage input wired to the corresponding terminals and with proper polarity.
3. If the status indicators indicate that the module is communicating as expected and all module wiring is correct, complete the following tasks.
   a. Disconnect the transmitter from the channel in question.
   b. Connect a known voltage/current source directly to the module.

      A known voltage/current source provides voltage/current at the channel equivalent to the voltage/current expected from the transmitter.

      – If the voltage/current reports back correctly then the module is performing as expected. In this case, the transmitter or wiring are likely the cause.
      – If the applied voltage/current source is not reporting back correctly, then the module hardware, configuration, or the software application are likely the cause.

      We **highly recommend** using a known voltage/current source for initial troubleshooting.

If the previously listed tasks fail to resolve your issue with incorrect voltage or current readings on your module, use the following table.

Table 18 - 1756-IF8I Module - Troubleshoot Incorrect Input Voltage/Current Readings

Possible Cause of Incorrect Reading	Description		Recommended Action
Open wire	When the module is used in **Voltage mode** and any of the following: • A wire is disconnected from the module. • A 4-wire transmitter has no power applied.	The following occurs: • Input data for that channel changes to the scaled value associated with the **overrange** signal value of the selected operational range. • The *I.Ch[x].Overrange* (x=channel number) tag is set to 1.	• Check the wiring to verify that all wires are connected. • Verify that the 4-wire transmitter, if used, is powered.
	When the module is used in **Current mode** and any of the following: • A wire is disconnected from the module. • The RTB is disconnected from the module. • The external loop power is not wired correctly, not working or the module is configured to supply loop power and is not required. • The module supplied loop power is not wired correctly, not working or not configured to supply loop power when required.	The following occurs: • Input data for that channel changes to the scaled value associated with the **underrange** signal value of the selected operational range. • The *I.Ch[x].Underrange* (x=channel number) tag is set to 1.	• Check all wiring to verify that all wires are connected. • Check the RTB to verify that it is fully seated on the module. • If an external power source is providing loop power, verify the following: – The external power source is properly wired. – Module configuration accurately indicates that an external power source is providing loop power. • If the module is providing loop power internally, verify the following: – The module is properly wired. – Module configuration accurately indicates that loop power is being supplied internally.
Short-circuited input	Reading the minimum can mean that there is a short-circuited input.		Check wiring and correct terminations.
Incorrect polarity	The wiring polarity of the transmitter and loop power must match the wiring diagrams, or negative readings can result		Check wiring polarity of the transmitter and the loop power source
Electrical noise	Erratic readings, that is, data fluctuating more than is typical, are a cause of noise. An oscilloscope shows the magnitude of noise.		• Disconnect all but one input to see if channels are affecting each other, that is, there is bleed-over. • Eliminate or suppress the effect of noise. Employ hardware or software filters provided by the 1756-IF8I module, such as the Notch Filter.

Table 18 - 1756-IF8I Module - Troubleshoot Incorrect Input Voltage/Current Readings

Possible Cause of Incorrect Reading	Description	Recommended Action
DC signal on top of the input signal	Offset readings can be caused by a DC signal riding on top of the input signal. An oscilloscope shows the magnitude of the offset.	Disconnect all but one input to see if channels are affecting each other, that is, there is bleed-over.
Module is in calibration mode	Incorrect readings can be a result of the module being calibrated when the reading occurs.	Make sure the module is not in calibration mode. This symptom is module dependent, but in general, specific bits have to be turned on to enable calibration.
Incorrect reading soon after module installation	One of the following: • Incorrect readings at initial module installation and configuration are often the result of installation and configuration errors. • Incorrect readings at installation of an existing, previously-working module are more likely the result of a hardware failure.	One of the following: • If error is occurring on a new module installation and configuration, make sure that those tasks were completed corrected and correct any errors you find. • If the error is occurring on an existing, previously-working module, diagnose the hardware failure and correct it. If more than one channel is experiencing the incorrect readings in this case, disconnect all inputs except one. This can help determine if it is external hardware or the module itself is the cause.
One of the following: • Short-circuit condition - Typically, caused by a short between terminal. With this module the short is between terminals IN_*x*/I/SRC and RTN_*x* (where *x* is the channel number). • Sourcing overcurrent condition - Caused by a current signal >24 mA.	When a short-circuit or sourcing overcurrent condition exists, the module sets the input to 24 mA, that is, the equivalent engineering unit value. This value indicates a special error condition beyond the normal Overrange value, that is, 21 mA: The following events occur: 1. For one second, the short-circuit or overcurrent condition self-corrects if the condition trigger is removed. 2. After one second, the condition latches, the channel disables Source Loop. 3. Current and continue to send 24 mA with an Overrange indication.	Check wiring and correct terminations. To unlatch the condition after the conditioning trigger is removed, perform one of the following: • Cycle power to the module. • Reset the module. • Inhibit and uninhibit the module.
Sensor Offset	The software configured Sensor Offset value is summed with the input data value	Insure that the Sensor Offset feature is desired.
Programming and Configuration	One of the following: • The input value is not read from correct data tag. • The channel is not configured for correct range. • The Signal and Engineering units are not set correctly.	If the incorrect input data value is in a secondary location, for example, an HMI device, verify the base tag value is in the controller. Correct programming or configuration as needed.

1756-OF8I Module - Incorrect Output Voltage/Current Readings

To determine the cause of the incorrect reading, first determine the nature of the incorrect reading. For example, the module can perform as follows:

- The module always outputs maximum.
- The module always outputs zero.
- The module outputs a smaller value than expected.
- The module outputs erratic voltage/current data.

First, complete the following tasks.

1. Check the status indicators to verify that the module is powered and communicating.

   Red or flashing green status indicators indicate a problem. For more information on the 1756-OF8I module status indicators, page 159.

2. Make sure wiring is intact and correct, current or voltage input wired to the corresponding terminals and with proper polarity.
3. If the status indicators indicate that the module is communicating as expected and all module wiring is correct, complete the following tasks.
   a. Disconnect the load from the channel in question.
   b. Insert a resistor with the module's voltage/current output range.
   c. With a voltmeter or in line current meter, verify that the voltage or current is as expected.
   – If the voltage/current reads correctly the module is performing as expected. In this case, the load or wiring are likely the cause.
   – If the sourcing voltage/current is not read back correctly, then the module hardware, configuration, or the software application are suspect.

If the previously listed tasks fail to resolve your issue with incorrect voltage or current readings on your module, use the following table.

Table 19 - 1756-OF8I Module - Troubleshoot Incorrect Input Voltage/Current Readings

Possible Cause of Incorrect Output	Description	Recommended Action
Open wire	One of the following: • The load does not respond to the applied voltage/current output. • A wire is disconnected from the module. • The RTB is disconnected from the module.	One of the following: • Check that the load is functioning properly. • Check wiring to verify that all wires are connected. • Check the RTB to verify that it is fully seated on the module.
Short-circuited output	Reading minimum (downscale) can mean that there is a short-circuited output. One of the following: • Output to return short. • Short to supply power. • Short to ground.	Check wiring and correct terminations.
Electrical noise	Erratic readings, that is, data fluctuating more than is typical, are a cause of noise. An oscilloscope shows the magnitude of noise.	• Disconnect all but one output to see if channels are affecting each other, that is, there is bleed-over. • Eliminate or suppress the effect of noise. Employ hardware or software filters provided by the 1756-OF8I module.
DC signal on top of the output signal	Offset readings can be caused by a DC signal riding on top of the output signal. An oscilloscope shows the magnitude of the offset.	Disconnect all but one input to see if channels are affecting each other, that is, there is bleed-over.
Module is in calibration mode	Incorrect readings can be a result of the module being calibrated when the reading occurs.	Make sure the module is not in calibration mode. This symptom is module dependent, but in general, specific bits have to be turned on to enable calibration.
Incorrect reading soon after module installation	One of the following: • Incorrect readings at initial module installation and configuration are often the result of installation and configuration errors. • Incorrect readings at installation of an existing, previously-working module are more likely the result of a hardware failure.	One of the following: • If error is occurring on a new module installation and configuration, make sure that those tasks were completed corrected and correct any errors you find. • If the error is occurring on an existing, previously-working module, diagnose the hardware failure and correct it. If more than one channel is experiencing the incorrect readings in this case, disconnect all outputs except one. This can help determine if it is external hardware or the module itself is the cause.
Load Compatibility	The module is capable of driving current input load impedance of up to 1000 ohms. The module is capable of driving voltage input load impedance of 1000 ohms.	Verify the loop impedance of the load driven by the module.
Invalid Clamp Values	Check the Clamp values on the module configuration Limits tab. They are **not** automatically changed when the scaling engineering units are changed. If they are not changed a small value of voltage/current out results.	Change the Clamp values with respect to the scaling engineering units.
Hold for Initialization	If this feature is used, the output value does not change (hold value) until the commanded value is at the output screw terminal within 0.1% of full scale.	Verify that the Hold for Initialization feature is desired.
Channel Offset	The software configured Channel Offset value is summed with the output.	Verify that the Channel Offset feature is desired.
Programming and Configuration	One of the following: • The output value is written to the incorrect data tag. • The channel is not configured for correct range. • The Signal and Engineering units are not set correctly.	If the incorrect output data is written from a secondary location, for example, an HMI device, verify that the output base tag value is correct in the controller. Correct programming or configuration as needed.

Isolated Analog I/O Module Tag Definitions

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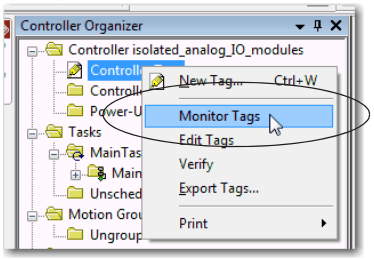
Module tags are created when you add a module to the Logix Designer application project. The set of tags associated with any module depends on the module type and the connection type. There are three sets of tags for each module:

- Configuration
- Input
- Output

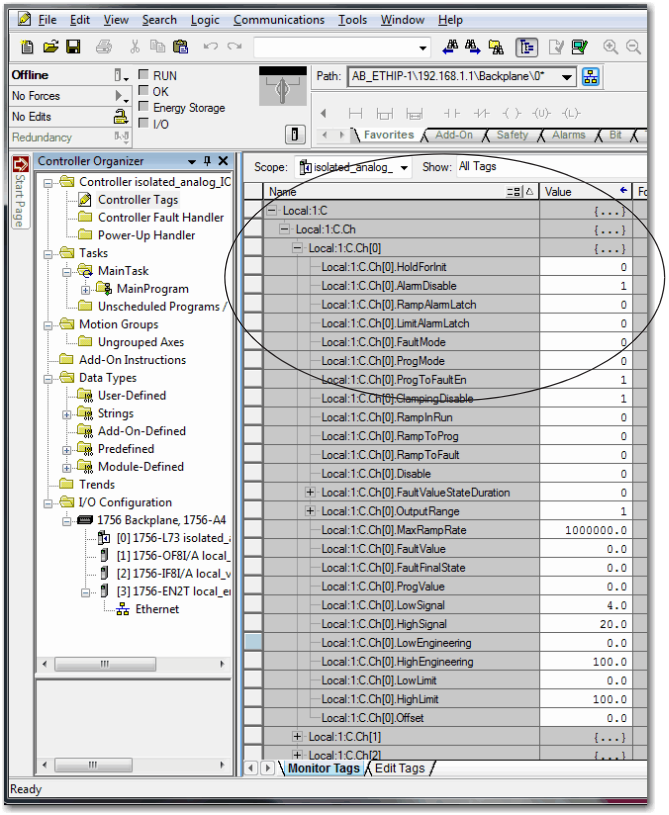
Access the Tags

You can view tags from the Tag Editor. Complete the following steps.

1. Open your Logix Designer application project.
2. Right-click Controller Tags and choose Monitor.



3. Open the tags as needed to view specific tags.



1756-IF8I Module Tags

This section describes the tags associated with the 1756-IF8I module.

IMPORTANT Each application's series of tags varies but no input module application contains any tags that are not listed here.

Configuration Tags

The following table describes the Configuration tags associated with the 1756-IF8I module.

Table 20 - 1756-IF8I Module - Configuration Tags

Tag Name	Size	Definition	Valid Values
Ch[x].InputRange	SINT	Channel's operating range.	• 0 = -10…10V • 1 = 0…5V • 2 = 0…10V • 3 = 0…20 mA (default)
Ch[x].NotchFilter	SINT	Notch Filter removes line noise for the channel. There is a relationship between this setting and the RPI setting. For more information on Notch Filter, see page 48.	• 0 = 10 Hz • 1 = 50 Hz • 2 = 60 Hz (default) • 3 = 100 Hz • 5 = 1000 Hz • 6 = 20 Hz • 7 = 15 Hz • 8 = 500 Hz • 9 = 5000 Hz • 10 = 5 Hz
Ch[x].AlarmDisable	BOOL	Disables all alarms on the module.	• 0 = Enabled • 1 = Disabled (default)
Ch[x].ProcessAlarmLatch	BOOL	Latches all Process alarms if they are configured not to clear until explicitly unlatched.	• 0 = Latching disabled (default) • 1 = Latching enabled
Ch[x].RateAlarmLatch	BOOL	Latches all Rate Alarms when set so that they do not clear until explicitly unlatched.	• 0 = Latching disabled (default) • 1 = Latching enabled
Ch[x]. Disable	BOOL	Disables the channel.	• 0 = Enabled (default) • 1 = Disabled
Ch[x].Sourcing	BOOL	When in current mode, indicates if channel is Sinking or Sourcing.	• 0 = Sinking (default) • 1 = Sourcing
Ch[x].SynchronizeSampling	BOOL	Determines if the sampling of the channel is synchronized with other channels configured as synchronized.	• 0 = Not synchronized (default) • 1 = Synchronized
Ch[x].DigitalFilter	INT	Time Constant for a First Order Lag filter.	0…32,767 ms (0 = default)

Table 20 - 1756-IF8I Module - Configuration Tags

Tag Name	Size	Definition	Valid Values
Ch[x].RateAlarmLimit	REAL	Rate of change in Engineering Units/Second If the absolute value of the change between samples divided by the sample time exceeds this value, the *I.Ch[x].RateAlarm* tag is sets.	Any positive value 0.0 = default (This value represents no change between samples.)
Ch[x].LowSignal	REAL	Signal value that lets you scale signal units (V, mA) into Engineering Units. Corresponds to the *C.Ch[x].LowEngineering* tag. That is, this tag's value is scaled to the lowest Engineering Unit. For more information on how Signal values correspond to Engineering values, see page 37	Any value that is less than the *C.Ch[x].HighSignal* tag value. • Current input type: 4.0 mA = default • Voltage input type: -10.0V= default
Ch[x].HighSignal	REAL	Signal scaling value that lets you scale signal units (V, mA) into Engineering Units. Corresponds to the *C.Ch[x].HighEngineering* tag. That is, this tag's value is scaled to the highest Engineering Unit. For more information on how Signal values correspond to Engineering values, see page 37	Any value that is greater than the *C.Ch[x].LowSignal* tag value • Current input type: 20.0 mA = default • Voltage input type: 10.0V= default
Ch[x].LowEngineering	REAL	Low engineering scaling point Corresponds to the *C.Ch[x].LowSignal* tag value. For more information on how Signal values correspond to Engineering values, see page 37	0.0 = default (In voltage applications, default = *C.Ch[x].LowSignal* tag value)
Ch[x].HighEngineering	REAL	High engineering scaling point Corresponds to the *C.Ch[x].HighSignal* tag value. For more information on how Signal values correspond to Engineering values, see page 37	100.0 = default (In voltage applications, default = *C.Ch[x].HighSignal* tag value)
Ch[x].LLAlarmLimit	REAL	Low Low Process Alarm limit Triggers the *I.Ch[x].LLAlarm* tag when the *I.Ch[x].Data* tag value is less than this tag's value.	0.0 = default
Ch[x].LAlarmLimit	REAL	Low Process Alarm limit Triggers the *I.Ch[x].LAlarm* tag when the *I.Ch[x].Data* tag value is less than this tag's value	0.0 = default
Ch[x].HAlarmLimit	REAL	High Process Alarm Limit Triggers the *I.Ch[x].HAlarm* tag when the *I.Ch[x].Data* tag value is greater than this tag's value.	100.0 = default
Ch[x].HHAlarmLimit	REAL	High High Process Alarm Limit Triggers the *I.Ch[x].HHAlarm* tag when the *I.Ch[x].Data* tag value is greater than this tag's value.	100.0 = default
Ch[x].AlarmDeadband	REAL	Deadband that keeps Process Alarms triggered as long as the *I.Ch[x].Data* tag value remains within the deadband of the Process Alarm's value	Any non-negative value 0.0 = default

Input Tags

The following table describes the Input tags associated with the 1756-IF8I module.

Table 21 - 1756-IF8I Module - Input Tags

Tag Name	Size	Definition	Valid Values
Fault	DINT	Standard Analog Fault mask – controller sets all 32 bits on connection loss.	• 0000_0000= Connection is good • FFFF_FFFF Hex = Connection has failed
CIPSyncValid	BOOL	Indicates whether the module has synchronized to a valid CIP Sync time master on the backplane at any point of current operation.	• 0 = CIP Sync is not available • 1 = CIP Sync is available
CIPSyncTimeout	BOOL	Indicates whether a valid time master on the backplane has timed out.	• 0 = A valid time master has not timed out. • 1 = A valid time master was detected on the backplane, but the time master has timed out. The module is currently using its local clock with old synchronized time data.
CIPSyncOffsetJump	BOOL	Indicates a significant jump, that is, 1 ms or greater, in the CST and CIP Sync times sent from the Timemaster to the module. (The Timemaster sends the CST and CIP Sync times to the module every second.) When a significant jump occurs, this tag value becomes 1 but changes to 0 a second later unless another jump occurred. We recommend that you refresh the Diagnostic Assembly to get more data on the jump if precise time tracking is important to your application.	• 0 = No significant jump occurred • 1 = Significant jump occurred
Ch[x].Fault	BOOL	Indicates that channel data is inaccurate and cannot be trusted for use in the application. If the tag is set to 1, you cannot trust the data reported. You must troubleshoot the module to correct the cause of the inaccuracy.	• 0 = Good • 1 = Bad
Ch[x].Uncertain	BOOL	Indicates that channel data can be inaccurate but it is not known to what degree of inaccuracy. If the tag is set to 1, you know the data can be inaccurate but you can troubleshoot the module to discover what degree of inaccuracy exists.	• 0 = Good • 1 = Uncertain
Ch[x].Underrange	BOOL	Indicates the channel data is beneath the absolute minimum for this channel. For example, when the channel operates in the 0…20 mA input range, the underrange threshold on the channel is $\leq$ 3.6 mA. If the input signal is 0 mA, this tag is set to 1.	• 0 = Channel data is not beneath the absolute minimum • 1 = Channel data is beneath the absolute minimum

Table 21 - 1756-IF8I Module - Input Tags

Tag Name	Size	Definition	Valid Values
Ch[x].Overrange	BOOL	Indicates the channel data is above the absolute maximum for this channel. For example, when the channel operates in the 0…20 mA input range, the absolute maximum on the channel is ≥ 21.0 mA. If the input signal is 22 mA, this tag is set to 1.	• 0 = Channel data is not above the absolute minimum • 1 = Channel data is above the absolute minimum
Ch[x].LLAlarm	BOOL	Triggered when the *I.Ch[x].Data* tag value is less than the *C.Ch[x].LLAlarmLimit*. tag value. If latched, this tag remains set until unlatched or if the *I.Ch[x].Data* tag value is within Deadband.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Ch[x].LAlarm	BOOL	Triggered when the *I.Ch[x].Data* tag value is less than the *C.Ch[x].LAlarmLimit* tag value. If latched, this tag remains set until unlatched or if the *I.Ch[x].Data* tag value is within Deadband.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Ch[x].HAlarm	BOOL	Triggered when the *I.Ch[x].Data* tag value is greater than the *C.Ch[x].HAlarmLimit* tag value. If latched, this tag remains set until unlatched or if the *I.Ch[x].Data* tag value is within Deadband.	• 0 = Alarm is not triggered • 1 = Alarm is set
Ch[x].HHAlarm	BOOL	Triggered when the *I.Ch[x].Data* tag value is greater than the *C.Ch[x].HHAlarmLimit* tag value. If latched, this tag remains set until unlatched or if the *I.Ch[x].Data* tag value is within Deadband.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Ch[x].RateAlarm	BOOL	Triggered when the absolute change between consecutive channel samples exceeds the *C.Ch[x].RateAlarmLimit* tag value. If latched, this tag remains set until it is unlatched.	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Ch[x].CalibrationFault	BOOL	Indicates the last attempted Calibration for this channel failed. This tag is cleared, that is, set to 0, when power is cycled to the module.	• 0 = Calibration did not fail • 1 = Calibration failed
Ch[x].Calibrating	BOOL	Indicates the channel is currently being calibrated.	• 0 = Channel is not being calibrated • 1 = Channel is being calibrated
Ch[x].CalGoodLowRef	BOOL	Indicates that a valid Low Reference signal has been sampled on this channel.	• 0 = Valid Low Reference signal has not been sampled on this channel • 1 = Valid Low Reference signal has been sampled on this channel
Ch[x].CalBadLowRef	BOOL	Indicates that an invalid Low Reference signal has been sampled on this channel. You must correct this condition to successfully calibrate the module. If calibration is aborted with an invalid Low Reference signal, the *I.Ch[x].CalibrationFault* tag is set for this channel until a successful calibration is performed.	• 0 = Invalid Low Reference signal has not been sampled on this channel • 1 = Invalid Low Reference signal has been sampled on this channel

Table 21 - 1756-IF8I Module - Input Tags

Tag Name	Size	Definition	Valid Values
Ch[x].CalGoodHighRef	BOOL	Indicates that a valid High Reference signal has been sampled on this channel.	• 0 = Valid High Reference signal has not been sampled on this channel • 1 = Valid High Reference signal has been sampled on this channel
Ch[x].CalBadHighRef	BOOL	Indicates that an invalid High Reference signal has been sampled on this channel. You must correct this condition to successfully calibrate the module. If calibration is aborted with an invalid High Reference signal, the *I.Ch[x].CalibrationFault* tag is set for this channel until a successful calibration is performed.	• 0 = Invalid High Reference signal has not been sampled on this channel • 1 = Invalid High Reference signal has been sampled on this channel
Ch[x].CalSuccessful	BOOL	Indicates calibration on this channel is complete and the Calibrating state has been exited. This tag remains set after valid calibration as long as connection is open.	• 0 = Calibration was not successful • 1 = Calibration was successful and calibrating state has been exited.
Ch[x].RateOfChange	REAL	Change in channel data since last sample in Engineering Units/Second.	Value representing the rate of change 0.0 = default (This value indicates no change occurred since sample.)
Ch[x].Data	REAL	Channel data in scaled Engineering Units.	Any positive or negative value. Determined by how you set the scaling parameters on the channel. For more information, see Scaling on page 37.
Timestamp	DINT[2]	64-bit timestamp indicating when all 8 channels were last sampled in terms of CIPSync time.	CIPSync Timestamp data
RollingTimestamp	DINT	16-bit timestamp that 'rolls' from 0…32,767 ms. Compatible with existing PID/PIDE instructions to automatically calculate sample deltas. With this module, this PID/PIDE instruction uses the RPI because there is no RTS available. For more information on the Rolling Timestamp, see page 21.	0…32,767 ms; where 1 ms = 1 count

Output Tags

The following table describes the Output tags associated with the 1756-IF8I module.

Table 22 - 1756-IF8I Module - Output Tags

Tag Name	Size	Definition	Valid Values
Ch[x].LLAlarmEn	BOOL	Enables the Low Low Process alarm.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Ch[x].LAlarmEn	BOOL	Enables the Low Process alarm.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Ch[x].HAlarmEn	BOOL	Enables the High Process alarm.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Ch[x].HHAlarmEn	BOOL	Enables the High High Process alarm.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Ch[x].LLAlarmUnlatch	BOOL	Unlatches a latched Low Low Alarm at the first instance of the bit transitioning from 0 to 1. For example, if the controller sends data for this tag in successive instances as 0, 1, 1, 1, 1, the module unlatches the Low Low alarm when it receives the first 1. The following instances of this tag value being 1 do not impact the Low Low alarm unlatching.	• 0 = LLAlarm remains latched • 1 = LLAlarm unlatches
Ch[x].LAlarmUnlatch	BOOL	Unlatches a latched Low Alarm at the first instance of the bit transitioning from 0 to 1. For example, if the controller sends data for this tag in successive instances as 0, 1, 1, 1, 1, the module unlatches the Low alarm when it receives the first 1. The following instances of this tag value being 1 do not impact the Low alarm unlatching.	• 0 = Low Alarm remains latched • 1 = Low Alarm unlatches
Ch[x].HAlarmUnlatch	BOOL	Unlatches a latched High Alarm at the first instance of the bit transitioning from 0 to 1. For example, if the controller sends data for this tag in successive instances as 0, 1, 1, 1, 1, the module unlatches the High alarm when it receives the first 1. The following instances of this tag value being 1 do not impact the High alarm unlatching.	• 0 = High Alarm remains latched • 1 = High Alarm unlatches
Ch[x].HHAlarmUnlatch	BOOL	Unlatches a set High High Alarm at the first instance of the bit transitioning from 0 to 1. For example, if the controller sends data for this tag in successive instances as 0, 1, 1, 1, 1, the module unlatches the High High alarm when it receives the first 1. The following instances of this tag value being 1 do not impact the High High alarm unlatching.	• 0 = High High Alarm remains latched • 1 = HHAlarm unlatches

Table 22 - 1756-IF8I Module - Output Tags

Tag Name	Size	Definition	Valid Values
Ch[x].RateAlarmUnlatch	BOOL	Unlatches a set Rate Alarm at the first instance of the bit transitioning from 0 to 1. For example, if the controller sends data for this tag in successive instances as 0, 1, 1, 1, 1, the module unlatches the Process alarm when it receives the first 1. The following instances of this tag value being 1 do not impact the Process alarm unlatching.	• 0 = Rate Alarm remains latched • 1 = Rate Alarm unlatches
Ch[x].Calibrate	BOOL	Initiates the Calibration process. This tag must remain set until a valid Low Reference and High Reference values are applied to the input. If the tag value transitions to 0 before calibration is finished, the process stops and calibration fails.	• 0 = Cali bration process is not started • 1 = Calibrtion process is started
Ch[x].CalLowReference	BOOL	Rising edge triggers the Low Calibration at the Low Reference Point for the current *C.Ch[x]nputRange* tag value. A valid Low Reference signal must be connected to the channel before setting this tag.	• 0 = Channel data value has not passed the Low Reference Point value • 1 = Channel data value has passed the Low Reference Point value
Ch[x].CalHighReference	BOOL	Rising edge triggers a High Calibration at the High Reference Point for the current *C.Ch[x]nputRange* tag value. A valid High Reference signal must be connected to the channel before setting tag.	• 0 = Channel data value has not passed the High Reference Point for the current *InputRange* tag value • 1 = Channel data value has passed the High Reference Point for the current *InputRange* tag value
Ch[x].SensorOffset	REAL	Compensates for any known error on the sensor or channel to which the sensor is connected.	Any (We recommend that you use a value in the channel's operating range.) 0.0 = default

1756-IRT8I Module Tags

This section describes the tags associated with the 1756-IRT8I module.

IMPORTANT Each application's series of tags varies but no input module application contains any tags that are not listed here.

Configuration Tags

The following table describes the Configuration tags associated with the 1756-IRT8I module.

Table 23 - 1756-IRT8I Module - Configuration Tags

Tag Name	Size	Definition	Valid Values
RemoteTermination	BOOL	Indicates CJC Sensor is connected remotely or locally. • If the CJC sensor if connected remotely, we recommend that you use an isothermal bar. With an isothermal bar, the CJC sensor is the same for all 8 channels. 1492 IFMs use a built-in isothermal bar. • If the CJC sensor is connected locally, thermal gradients exist on the RTB because heat rises. With an RTB, temperature differences exist between the CJC sensors. Correction factors are applied internally to account for the differences.	• 0 = CJC sensor is connected locally via the RTB • 1 = CJC sensor is connected remotely (default)
CJDisable	BOOL	Removes cold junction compensation from Thermocouple calculations. By default module configuration, cold junction is compensated for each Thermocouple channel returning temperature.	• 0 = CJ compensation enabled • 1 = No CJ compensation
CJOffset	REAL	User-defined offset value, measure in temperature units, to add to the channel's CJC sensor reading.	Default = 0.0 C
Ch[x].InputRange	SINT	Channel's operating range.	• 4 = -100…100 mV • 6 = 1…500 Ω • 7 = 2…1000 Ω • 8 = 4…2000 Ω • 9 = 8…4000 Ω

Table 23 - 1756-IRT8I Module - Configuration Tags

Tag Name	Size	Definition	Valid Values
Ch[x].SensorType	SINT	Sensor type used on the channel. The Input Type connected to the channel determine the sensor type	If an RTD input type is connected to the channel: • 0 = Ω • 1 = 100Ω PT 385 • 2 = 200Ω PT 385 • 3 = 500Ω PT 385 • 4 = 1000Ω PT 385 • 5 = 100Ω PT 3916 • 6 = 200Ω PT 3916 • 7 = 500Ω PT 3916 • 8 = 1000Ω PT 3916 • 9 = 10Ω CU 427 • 10 = 120Ω NI 672 • 11 = 100Ω NI 618 • 12 = 120Ω NI 618 • 13 = 200Ω NI 618 • 14 = 500Ω NI 618 If a Thermocouple input type is connected to the channel: • 0 = mV • 1 = B • 2 = C • 3 = E • 4 = J • 5 = K • 6 = N • 7 = R • 8 = S • 9 = T • 10 = TXK/XK(L) • 11 = D
Ch[x].NotchFilter	SINT	Notch Filter removes line noise for the channel. There is a relationship between this setting and the RPI setting. For more information on Notch Filter, see page 67.	• 0 = 10 Hz • 1 = 50 Hz • 2 = 60 Hz • 3 = 100 Hz • 5 = 1000 Hz • 6 = 20 Hz • 7 = 15 Hz • 8 = 500 Hz • 9 = 5000 Hz • 10 = 5 Hz

Table 23 - 1756-IRT8I Module - Configuration Tags

Tag Name	Size	Definition	Valid Values
Ch[x].AlarmDisable	BOOL	Disables all alarms on the module.	• 0 = Enabled • 1 = Disabled (default)
Ch[x].ProcessAlarmLatch	BOOL	Latches all Process alarms if they are configured not clear until explicitly unlatched.	• 0 = Latching disabled (default) • 1 = Latching enabled
Ch[x].RateAlarmLatch	BOOL	Latches all Rate alarms when they are configured not to clear until explicitly unlatched.	• 0 = Latching disabled (default) • 1 = Latching enabled
Ch[x].Disable	BOOL	Disables the channel.	• 0 = Enabled (default) • 1 = Disabled
Ch[x]. TempEnglish	BOOL	Used with the TempAbsolute tag for the same channel to determine the temperature units for the channel when linearizing (non-zero sensor type).	• 0 = Standard (default) • 1 = English **IMPORTANT**: The combination of this value with that of the TempAbsolute tag value determine the temperature unit used. For example, if TempEnglish = 0 and TempAbsolute = 0, the combination is 00. Thus, Celsius units are used. The following combinations are possible: • 00 = Celsius • 01 = Fahrenheit • 10 = Kelvin • 11 = Rankine
Ch[x].TempAbsolute	BOOL	Used with the TempEnglish tag for the same channel to determine the temperature units for the channel when linearizing (non-zero sensor type).	• 0 = Familiar (default) • 1 = Absolute **IMPORTANT**: See the TempEnglish tag Valid Values description for more information on using this tag's value.
Ch[x].FourWireRTD	BOOL	Sets what type of RTD, that is, 3-wire or 4-wire, is connected to the channel.	• 0 = 3-wire RTD (default) • 1 = 4-wire RTD
Ch[x].SynchronizeSampling	BOOL	Determines if the sampling of the channel is synchronized with other channels configured for synchronized sampling.	• 0 = Not synchronized (default) • 1 = Synchronized
Ch[x].TenOhmOffset	INT	Specific offset for 10 Ohm Copper Sensor Type. Value is measured in **Hundredths of Ω** with 2 implied decimal places.	-100…100 in hundredths of Ω 0 = default

Table 23 - 1756-IRT8I Module - Configuration Tags

Tag Name	Size	Definition	Valid Values
Ch[x].DigitalFilter	INT	Time Constant for a First Order Lag filter	0…32,767 ms 0 = default
Ch[x].RateAlarmLimit	REAL	Rate of change in Engineering Units/Second If the absolute value of the change between samples divided by the sample time exceeds this value, the *I.Ch[x].RateAlarm* tag is sets.	Any positive value 0.0 = default (This value represents no change between samples.)
Ch[x].LowSignal	REAL	Signal scaling value that lets you scale signal units (mV, Ω, °F or °C) into Engineering Units. Corresponds to the *C.Ch[x].LowEngineering* tag. That is, this tag's value is scaled to the lowest Engineering Unit.	Any value that is less than the *C.Ch[x].HighSignal* tag value. 0 = default
Ch[x].HighSignal	REAL	Signal scaling value that lets you scale signal units (mV, Ω, °F or °C) into Engineering Units. Corresponds to the *C.Ch[x].HighEngineering* tag. That is, this tag's value is scaled to the highest Engineering Unit.	Any value that is greater than the *C.Ch[x].LowSignal* tag value. 100.0 = default
Ch[x].LowEngineering	REAL	Low engineering scaling point Corresponds to the *C.Ch[x].LowSignal* tag value.	0.0 = default This value can correspond to signal values in units or temperature.
Ch[x].HighEngineering	REAL	High engineering scaling point Corresponds to the *C.Ch[x].HighSignal* tag value.	100.0 = default This value can correspond to signal values in units or temperature.
Ch[x].LLAlarmLimit	REAL	Low Low Process Alarm limit Triggers the *I.Ch[x].LLAlarm* tag when the *I.Ch[x].Data* tag value is less than this tag's value.	0.0 = default
Ch[x].LAlarmLimit	REAL	Low Process Alarm limit Triggers the *I.Ch[x].LAlarm* tag when the *I.Ch[x].Data* tag value is less than this tag's value	0.0 = default
Ch[x].HAlarmLimit	REAL	High Process Alarm Limit Triggers the *I.Ch[x].HAlarm* tag when the *I.Ch[x].Data* tag value is greater than this tag's value.	100.0 = default
Ch[x].HHAlarmLimit	REAL	High High Process Alarm Limit Triggers the *I.Ch[x].HHAlarm* tag when the *I.Ch[x].Data* tag value is greater than this tag's value.	100.0 = default
Ch[x].AlarmDeadband	REAL	Deadband that keeps Process Alarms triggered as long as the *I.Ch[x].Data* tag value remains within the deadband of the Process Alarm's value	Any positive value 0.0 = default

Input Tags

The following table describes the Input tags associated with the 1756-IRT8I module.

Table 24 - 1756-IRT8I Module - Input Tags

Tag Name	Size	Definition	Valid Values
Fault	DINT	Standard Analog Fault mask – controller sets all 32 bits on connection loss.	• 0000_0000= Connection is good • FFFF_FFFF Hex = Connection has failed
CIPSyncValid	BOOL	Indicates whether the module has synchronized to a valid CIP Sync time master on the backplane.	• 0 = CIP Sync is not available • 1 = CIP Sync is available
CIPSyncTimeout	BOOL	Indicates whether a valid time master on the backplane has timed out.	• 0 = A valid time master has not timed out. • 1 = A valid time master was detected on the backplane, but the time master has timed out. The module is currently using its local clock with old synchronized time data.
CIPSyncOffsetJump	BOOL	Indicates a significant jump, that is, 1 ms or greater, in the CST and CIP Sync times sent from the Timemaster to the module. (The Timemaster sends the CST and CIP Sync times to the module every second.) When a significant jump occurs, this tag value becomes 1 but changes to 0 a second later unless another jump occurred. We recommend that you refresh the Diagnostic Assembly to get more data on the jump if precise time tracking is important to your application.	• 0 = No significant jump occurred • 1 = Significant jump occurred
CJ[0].Underrange CJ[1]Underrange	BOOL	The cold junction at channel *x* is below 0 °C.	• 0 = Cold junction is not below 0 °C • 1 = Cold junction is below 0 °C
CJ[0].Overrange CJ[1].Overrange	BOOL	The cold junction at channel *x* is above 86 °C.	• 0 = Cold junction is not above 86 °C • 1 = Cold junction is above 86 °C
CJ[0].Data CJ[1].Data	REAL	The cold junction at the top module terminal, that is, CJ[0], or the bottom module terminal, that is, CJ[1] *x* in Celsius.	
Ch[x].Fault	BOOL	Quality of channel data.	• 0 = Good • 1 = Bad
Ch[x].Uncertain	BOOL	Channel data can be imperfect.	• 0 = Good • 1 = Uncertain

Table 24 - 1756-IRT8I Module - Input Tags

Tag Name	Size	Definition	Valid Values
Ch[x].Underrange	BOOL	Indicates the channel data is beneath the absolute minimum for this channel. For example, when the channel operates in the -100…100 mV input range, the absolute minimum on the channel is -101.00 mV. If the input signal is -102.00 mV, this tag is set to 1.	• 0 = Channel is not beneath the absolute minimum • 1 = Channel is beneath the absolute minimum
Ch[x].Overrange	BOOL	Indicates the channel data is above the absolute maximum for this channel. For example, when the channel operates in the -100…100 mV input range, the absolute maximum on the channel is 101.00 mV. If the input signal is 102.00 mV, this tag is set to 1.	• 0 = Channel is not above the absolute minimum • 1 = Channel is above the absolute minimum
Ch[x].LLAlarm	BOOL	Triggered when the *I.Ch[x].Data* tag value is less than the *C.Ch[x].LLAlarmLimit*. tag value If latched, this tag remains set until unlatched or if the *I.Ch[x].Data* tag value is within Deadband	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Ch[x].LAlarm	BOOL	Triggered when the *I.Ch[x].Data* tag value is less than the *C.Ch[x].LAlarmLimit* tag value If latched, this tag remains set until unlatched or if the *I.Ch[x].Data* tag value is within Deadband	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Ch[x].HAlarm	BOOL	Triggered when the *I.Ch[x].Data* tag value is greater than the *C.Ch[x].HAlarmLimit* tag value If latched, this tag remains set until unlatched or if the *I.Ch[x].Data* tag value is within Deadband	• 0 = Alarm is not triggered • 1 = Alarm is set
Ch[x].HHAlarm	BOOL	Triggered when the *I.Ch[x].Data* tag value is greater than the *C.Ch[x].HHAlarmLimit* tag value If latched, this tag remains set until unlatched or if the *I.Ch[x].Data* tag value is within Deadband	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Ch[x].RateAlarm	BOOL	Triggered when the absolute change between consecutive channel samples exceeds the *C.Ch[x].RateAlarmLimit* tag value If latched, this tag remains set until it is unlatched	• 0 = Alarm is not triggered • 1 = Alarm is triggered
Ch[x].CalibrationFault	BOOL	Indicates the last attempted Calibration for this channel failed. This tag is cleared, that is, set to 0, when power is cycled to the module.	• 0 = Calibration did not fail • 1 = Calibration failed
Ch[x].Calibrating	BOOL	Indicates the channel is currently being calibrated.	• 0 = Channel is not being calibrated • 1 = Channel is being calibrated
Ch[x].CalGoodLowRef	BOOL	Indicates that a valid Low Reference signal has been sampled on this channel.	• 0 = Valid Low Reference signal has not been sampled on this channel • 1 = Valid Low Reference signal has been sampled on this channel

Table 24 - 1756-IRT8I Module - Input Tags

Tag Name	Size	Definition	Valid Values
Ch[x].CalBadLowRef	BOOL	Indicates that an invalid Low Reference signal has been sampled on this channel. You must correct this condition to successfully calibrate the module. If calibration is aborted with an invalid Low Reference signal, the *I.Ch[x].CalibrationFault* tag is set for this channel until a successful calibration is performed.	• 0 = Invalid Low Reference signal has not been sampled on this channel • 1 = Invalid Low Reference signal has been sampled on this channel
Ch[x].CalGoodHighRef	BOOL	Indicates that a valid High Reference signal has been sampled on this channel.	• 0 = Valid High Reference signal has not been sampled on this channel • 1 = Valid High Reference signal has been sampled on this channel
Ch[x].CalBadHighRef	BOOL	Indicates that an invalid High Reference signal has been sampled on this channel. You must correct this condition to successfully calibrate the module. If calibration is aborted with an invalid High Reference signal, the *I.Ch[x].CalibrationFault* tag is set for this channel until a successful calibration is performed.	• 0 = Invalid High Reference signal has not been sampled on this channel • 1 = Invalid High Reference signal has been sampled on this channel
Ch[x].CalSuccessful	BOOL	Indicates calibration on this channel is complete and the Calibrating state has been exited. This tag remains set after valid calibration as long as connection is open.	• 0 = Calibration was not successful • 1 = Calibration was successful and calibrating state has been exited.
Ch[x].RateOfChange	REAL	Indicates a change in channel data since last sample in Engineering Units/Second.	Value representing the rate of change
Ch[x].Data	REAL	Indicates channel data in scaled Engineering units.	Any positive or negative value. Determined by how you set the scaling parameters on the channel. For more information, see Scaling on page 37.
Timestamp	DINT[2]	64-bit timestamp value that indicates when all eight channels were last sampled. This value is provided in terms of CIPSync time.	CIPSync Timestamp data
RollingTimestamp	DINT	16-bit timestamp that 'rolls' from 0…32,767 ms. Compatible with existing PID/PIDE instructions to automatically calculate sample deltas. With this module, this PID/PIDE instruction uses the RPI because there is no RTS available. For more information on the Rolling Timestamp, see page 21.	0…32,767 ms; where 1 ms = 1 count

Output Tags

The following table describes the Output tags associated with the 1756-IRT8I module.

Table 25 - 1756-IRT8I Module - Output Tags

Tag Name	Size	Definition	Valid Values
Ch[x].LLAlarmEn	BOOL	Enables the Low Low Process alarm.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Ch[x].LAlarmEn	BOOL	Enables the Low Process alarm.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Ch[x].HAlarmEn	BOOL	Enables the High Process alarm.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Ch[x].HHAlarmEn	BOOL	Enables the High High Process alarm.	• 0 = Alarm is disabled • 1 = Alarm is enabled
Ch[x].LLAlarmUnlatch	BOOL	Unlatches a latched Low Low Alarm at the first instance of the bit transitioning from 0 to 1. For example, if the controller sends data for this tag in successive instances as 0, 1, 1, 1, 1, the module unlatches the Low Low alarm when it receives the first 1. The following instances of this tag value being 1 do not impact the Low Low alarm unlatching.	• 0 = LLAlarm remains latched • 1 = LLAlarm unlatches
Ch[x].LAlarmUnlatch	BOOL	Unlatches a latched Low Alarm at the first instance of the bit transitioning from 0 to 1. For example, if the controller sends data for this tag in successive instances as 0, 1, 1, 1, 1, the module unlatches the Low alarm when it receives the first 1. The following instances of this tag value being 1 do not impact the Low alarm unlatching.	• 0 = Low Alarm remains latched • 1 = Low Alarm unlatches
Ch[x].HAlarmUnlatch	BOOL	Unlatches a latched High Alarm at the first instance of the bit transitioning from 0 to 1. For example, if the controller sends data for this tag in successive instances as 0, 1, 1, 1, 1, the module unlatches the High alarm when it receives the first 1. The following instances of this tag value being 1 do not impact the High alarm unlatching.	• 0 = High Alarm remains latched • 1 = High Alarm unlatches
Ch[x].HHAlarmUnlatch	BOOL	Unlatches a latched High High Alarm at the first instance of the bit transitioning from 0 to 1. For example, if the controller sends data for this tag in successive instances as 0, 1, 1, 1, 1, the module unlatches the High High alarm when it receives the first 1. The following instances of this tag value being 1 do not impact the High High alarm unlatching.	• 0 = High High Alarm remains latched • 1 = HHAlarm unlatches

Table 25 - 1756-IRT8I Module - Output Tags

Tag Name	Size	Definition	Valid Values
Ch[x].RateAlarmUnlatch	BOOL	Unlatches a latched Rate Alarm at the first instance of the bit transitioning from 0 to 1. For example, if the controller sends data for this tag in successive instances as 0, 1, 1, 1, 1, the module unlatches the Process alarm when it receives the first 1. The following instances of this tag value being 1 do not impact the Process alarm unlatching.	• 0 = Rate Alarm remains latched • 1 = Rate Alarm unlatches
Ch[x].Calibrate	BOOL	Initiates the Calibration process. This tag must remain set until a valid Low Reference and High Reference values are applied to the channel.	• 0 = Calibration process is not started • 1 = Calibration process is started
Ch[x].CalLowReference	BOOL	Rising edge triggers the Low Calibration at the Low Reference Point for the current *InputRange* tag value. A valid Low Reference signal must be connected to the channel before setting this tag.	• 0 = Channel data value has not passed the Low Reference Point value • 1 = Channel data value has passed the Low Reference Point value
Ch[x].CalHighReference	BOOL	Rising edge triggers a High Calibration at the High Reference Point for the current *InputRange* tag value. A valid High Reference signal must be connected to the channel before setting tag.	• 0 = Channel data value has not passed the High Reference Point for the current *InputRange* tag value • 1 = Channel data value has passed the High Reference Point for the current *InputRange* tag value
Ch[x].SensorOffset	REAL	Compensates for any known error on the sensor or channel to which the sensor is connected.	Any (We recommend that you use a value in the channel's operating range.) 0.0 = default

1756-OF8I Module Tags

This section describes the tags associated with the 1756-OF8I module.

IMPORTANT Each application's series of tags varies but no output module application contains any tags that are not listed here.

Configuration Tags

The following table describes the Configuration tags associated with the 1756-OF8I module.

Table 26 - 1756-OF8I Module - Configuration Tags

Tag Name	Size	Definition	Valid Values
Ch[x].HoldForInit	BOOL	When this tag is set, the channel holds the current value until the received I:Ch[x].*Data* tag value is within 0.1% of the current Echo O:Ch[x].*Data* tag value. If this tag is set to Hold, the *I:Ch[x].InHold* tag is triggered when the module transitions into Run mode from a Program or Fault states.	• 0 = Not holding (default) • 1 = Holding
Ch[x].AlarmDisable	BOOL	Disables all alarms on the module.	• 0 = Alarms Enabled • 1 = Alarms Disabled (default)
Ch[x].RampAlarmLatch	BOOL	Latches the Ramp alarm. If this tag is set to latch the ramp alarm, the *I:Ch[x].RampAlarm* tag does not clear until explicitly unlatched.	• 0 = Latching disabled (default) • 1 = Latching enabled
Ch[x].LimitAlarmLatch	BOOL	Latches the Low alarm and the High alarms. If this tag is set to latch the alarms, the I:Ch[x].*LLimitAlarm* and I:Ch[x].*HLimitAlarm* tags do not clear until explicitly unlatched.	• 0 = Latching disabled (default) • 1 = Latching enabled
Ch[x].FaultMode	BOOL	Determines channel action when a fault occurs, for example, a connection loss. At the fault occurrence, the module holds its last state or transitions to the channel value used in the *C.Ch[x].FaultValue* tag. If configured to Hold Last State, the channel Holds Last State for the length of time set by the *C.Ch[x].FaultValueStateDuration* tag.	• 0 = Hold Last State (default) • 1 = Transition to fault channel value
Ch[x].ProgMode	BOOL	Determines channel action when the module transitions to Program mode. At the transition to Program mode, the module holds its last state or transitions to the channel value used in the *C.Ch[x].ProgValue* tag.	• 0 = Hold Last State (default) • 1 = Transition to program channel value

Table 26 - 1756-OF8I Module - Configuration Tags

Tag Name	Size	Definition	Valid Values
Ch[x].ProgToFaultEn	BOOL	Determines channel action if a connection faults while the module is in a safe state for Program mode. The channel can remain in the safe state for Program mode or transition to a safe state for Fault mode. If the channel remains in safe state for Program mode, the *C.Ch[x].FinalFaultState* tag value is ignored.	• 0 = Channel remains in the safe state for Program mode • 1 = Channel transitions to the safe state for the Fault mode
Ch[x].ClampingDisable	BOOL	Disables Clamping on the channel.	• 0 = Clamping enabled • 1 = Clamping disabled (default)
Ch[x].RampInRun	BOOL	Enables Output Ramping when the module is in Run mode. Output changes during Run mode are limited to the *C.Ch[x].MaxRampRate* tag value.	• 0 = Ramping disabled (default) • 1 = Ramping enabled in Run mode
Ch[x].RampToProg	BOOL	Enables Output Ramping when the channel is transitioning to Program mode. Output changesduring Program mode are limited to the *C.Ch[x].MaxRampRate* tag value.	• 0 = Ramping disabled (default) • 1 = Ramping enabled to Program mode state
Ch[x].RampToFault	BOOL	Enables Output Ramping when the channel is transitioning to Fault mode. Output changes during Fault mode are limited to the *C.Ch[x].MaxRampRate* tag value.	• 0 = Ramping disabled (default) • 1 = Ramping enabled to Fault mode state
Ch[x].Disable	BOOL	Disables the channel.	• 0 = Channel enabled (default) • 1 = Channel disabled
Ch[x].FaultValueStateDuration	SINT	Determines the length of time the *C.Ch[x].FaultValue* tag value is held prior to the *C.Ch[x].FaultFinalState* being applied.	• 0 = Hold forever (default) • Any of the following: – 1, 2, 5, or 10 seconds
Ch[x].OutputRange	SINT	Channel's operating range.	0 = -10…10V 1 = 0…20 mA (default) 2 = 0…5V 3 = 0…10V
Ch[x].MaxRampRate	REAL	Maximum rate at which the channel can transition to in Engineering Units/Second. This tag is used only if at least one of the following tags is enabled: • *C.Ch[x].RampInRun* • *C.Ch[x].RampToFault* • *C.Ch[x].RampToProgram*	Any value > 0.0 1,000,000.00 = default
Ch[x].FaultValue	REAL	Value to which the channel changes if the following events exist: • Connection is lost • *C.Ch[x].FaultMode* tag is enabled	Any 0.0 = default

Table 26 - 1756-OF8I Module - Configuration Tags

Tag Name	Size	Definition	Valid Values
Ch[x].FaultFinalState	REAL	Value to which the channel changes if the following events exist: • Connection is lost • Time defined by the *C.Ch[x].FaultValueStateDuration* tag has been exceeded	Any 0.0 = default
Ch[x].ProgValue	REAL	Value to which the channel changes if the following events exist: • Module transitions to Program mode • *C.Ch[x].ProgMode* tag is enabled	Any 0.0 = default
Ch[x].LowSignal	REAL	Signal value that lets you scale signal units (V, mA) into Engineering Units. Corresponds to the *C.Ch[x].LowEngineering* tag. That is, this tag's value is scaled to the lowest Engineering Unit.	Any value less the *C.Ch[x].HighSignal* tag value. Current input type: 4.0 = default Voltage input type: -10.0 = default
Ch[x].HighSignal	REAL	Signal scaling value that lets you scale signal units (V, mA) into Engineering Units. Corresponds to the *C.Ch[x].HighEngineering* tag. That is, this tag's value is scaled to the highest Engineering Unit.	Any value greater than the *C.Ch[x].LowSignal* tag value Current input type: 20.0 = default Voltage input type: 10.0 = default
Ch[x].LowEngineering	REAL	Low engineering scaling point Corresponds to the *C.Ch[x].LowSignal* tag value.	Any lower than the *C.Ch[x].HighEngineering* tag Default values: • 0.0 for current • -10.0 for voltage
Ch[x].HighEngineering	REAL	High engineering scaling point Corresponds to the *C.Ch[x].HighSignal* tag value.	Any higher than the *C.Ch[x].LowEngineering* tag Default values: • 100.0 for current • 10.0 for voltage
Ch[x].LowLimit	REAL	LowLimit setpoint below which the output cannot go when Clamping is enabled.	Any lower than the HighLimit 0.0 = default
Ch[x].HighLimit	REAL	HighLimit setpoint above which the output cannot go when Clamping is enabled.	Any higher than the LowLimit 0.0 = default
Ch[x].Offset	REAL	Compensates for any known error on the sensor or channel to which the sensor is connected. The value is set in signal units.	Any (We recommend that you use a small value.) 0.0 = default

Input Tags

The following table describes the Input tags associated with the 1756-OF8I module.

Table 27 - 1756-OF8I Module - Input Tags

Tag Name	Size	Definition	Valid Values
Fault	DINT	Standard Analog Fault mask – controller sets all 32 bits on connection loss.	• 0000_0000= Connection is good • FFFF_FFFF Hex = Connection has failed
CIPSyncValid	BOOL	Indicates whether the module has synchronized to a valid CIP Sync time master on the backplane.	• 0 = CIP Sync is not available • 1 = CIP Sync is available
CIPSyncTimeout	BOOL	Indicates whether a valid time master on the backplane has timed out.	• 0 = A valid time master has not timed out. • 1 = A valid time master was detected on the backplane, but the time master has timed out. The module is currently using its local clock and can be drifting away from the last known time master.
CIPSyncOffsetJump	BOOL	Indicates a significant jump, that is, 1 ms or greater, in the CST and CIP Sync times sent from the Timemaster to the module. (The Timemaster sends the CST and CIP Sync times to the module every second.) When a significant jump occurs, this tag value becomes 1 but changes to 0 a second later unless another jump occurred. We recommend that you refresh the Diagnostic Assembly to get more data on the jump if precise time tracking is important to your application.	• 0 = No significant jump occurred • 1 = Significant jump occurred
Ch[x].Fault	BOOL	Quality of channel data.	• 0 = Good • 1 = Bad
Ch[x].Uncertain	BOOL	Channel data can be imperfect.	• 0 = Good • 1 = Uncertain
Ch[x].LowClampAlarm	BOOL	Channel data value that causes the channel to clamp in the following conditions: • Clamping is enabled on this channel, that is, the *C.Ch[x].ClampingDisable* tag value = 0 • *O.Ch[x].Data* tag value requested is less than the value configured in the *C.Ch[x].LowLimit* tag	• 0 = Channel is not clamped • 1 = Channel is clamped
Ch[x].HighClampAlarm	BOOL	Channel data value that causes the channel to clamp in the following conditions: • Clamping is enabled on this channel, that is, the *C.Ch[x].ClampingDisable* tag value = 0 • *O.Ch[x].Data* tag value requested is greater than the value configured in the *C.Ch[x].HighLimit* tag	• 0 = Channel is not clamped • 1 = Channel is clamped
Ch[x].RampAlarm	BOOL	Indicates that the channel is currently limited to changing at the *C.Ch[x].MaxRampRate* tag value or is latched.	• 0 = Channel is not limited to the *C.Ch[x].MaxRampRate* tag value or latched • 1 = channel is limited
Ch[x].NotANumber	BOOL	Indicates that the last value last received for the *O.Ch[x].Data* tag was not a number.	• 0 = Last channel data received was a number • 1 = Last channel data received was not a number

Table 27 - 1756-OF8I Module - Input Tags

Tag Name	Size	Definition	Valid Values
Ch[x].InHold	BOOL	Indicates that the channel is currently holding until the received *O.Ch[x].Data* tag value is within 0.1% of the current *I.Ch[x].Data* tag value.	• 0 = Channel is not holding • 1 = Channel is holding
Ch[x].CalibrationFault	BOOL	Indicates the last attempted Calibration for this channel failed. This tag is cleared, that is, set to 0, when power is cycled to the module.	• 0 = Calibration did not fail • 1 = Calibration failed
Ch[x].Calibrating	BOOL	Indicates the channel is currently being calibrated.	• 0 = Channel is not being calibrated • 1 = Channel is being calibrated
Ch[x].CalGoodLowRef	BOOL	Indicates that a valid Low Reference signal has been sampled on the channel.	• 0 = Valid Low Reference signal has not been sampled on this channel • 1 = Valid Low Reference signal has been sampled on this channel
Ch[x].CalBadLowRef	BOOL	Indicates that an invalid Low Reference signal has been sampled on this channel. You must correct this condition to successfully calibrate the module. If calibration is aborted with an invalid Low Reference signal, the *I.Ch[x].CalibrationFault* tag is set for this channel until a successful calibration is performed.	• 0 = Invalid Low Reference signal has not been sampled on this channel • 1 = Invalid Low Reference signal has been sampled on this channel
Ch[x].CalGoodHighRef	BOOL	Indicates that a valid High Reference signal has been sampled on this channel.	• 0 = Valid High Reference signal has not been sampled on this channel • 1 = Valid High Reference signal has been sampled on this channel
Ch[x].CalBadHighRef	BOOL	Indicates that an invalid High Reference signal has been sampled on this channel. You must correct this condition to successfully calibrate the module. If calibration is aborted with an invalid High Reference signal, the *I.Ch[x].CalibrationFault* tag is set for this channel until a successful calibration is performed.	• 0 = Invalid High Reference signal has not been sampled on this channel • 1 = Invalid High Reference signal has been sampled on this channel
Ch[x].CalSuccessful	BOOL	Indicates calibration on this channel is complete and the Calibrating state has been exited. This tag remains set after valid calibration as long as connection is open.	• 0 = Calibration was not successful • 1 = Calibration was successful and calibrating state has been exited.
Ch[x].Data	REAL	Output Data Echo data in scaled Engineering units.	Any positive or negative value. Determined by how you set the scaling parameters on the channel. For more information, see Scaling on page 37.
Timestamp	DINT[2]	64-bit timestamp value that indicates when any of the 8 channels were last updated with new Output Data. This value is provided in terms of CIPSync time.	Timestamp data
RollingTimestamp	DINT	16-bit timestamp that 'rolls' from 0…32,767 ms. Compatible with existing PID instruction to automatically calculate sample deltas. For more information on the Rolling Timestamp, see page 21.	0…32,767 ms where 1 ms = 1 count

Output Tags

The following table describes the Output tags associated with the 1756-OF8I module.

Table 28 - 1756-OF8I Module - Output Tags

Tag Name	Size	Definition	Valid Values
Ch[x].LLimitUnlatch	BOOL	Unlatches a latched Low Limit alarm at the first instance of the bit transitioning from 0 to 1. For example, if the controller sends data for this tag in successive instances as 0, 1, 1, 1, 1, the module unlatches the Low Limit alarm when it receives the first 1. The following instances of this tag value being 1 do not impact the Low Limit alarm unlatching.	• 0 = Alarm remains latched (default) • 1 = Alarm is unlatched
Ch[x].HLimitUnlatch	BOOL	Unlatches a latched High Limit alarm at the first instance of the bit transitioning from 0 to 1. For example, if the controller sends data for this tag in successive instances as 0, 1, 1, 1, 1, the module unlatches the High Limit alarm when it receives the first 1. The following instances of this tag value being 1 do not impact the High Limit alarm unlatching.	• 0 = Alarm remains latched (default) • 1 = Alarm is unlatched
Ch[x].RampAlarmUnlatch	BOOL	Unlatches a latched Ramp alarm at the first instance of the bit transitioning from 0 to 1. For example, if the controller sends data for this tag in successive instances as 0, 1, 1, 1, 1, the module unlatches the Ramp alarm when it receives the first 1. The following instances of this tag value being 1 do not impact the Ramp alarm unlatching.	• 0 = Alarm remains latched (default) • 1 = Alarm is unlatched
Ch[x].Calibrate	BOOL	Initiates the Calibration process. This tag must remain set until a valid Low Reference and High Reference values are applied to the channel.	• 0 = Calibration process is not started (default) • 1 = Calibration process is started
Ch[x].CalOutputLowRef	BOOL	Data value change that transitions the channel to produce the Low Calibration Reference Point for the current *C.Ch[x].OutputRange* tag value.	• 0 = Do not output Cal Low Reference • 1 = Output Calibration Low Reference Do not set his tag and the CalOutputHighRef tag to 1 simultaneously.

Table 28 - 1756-OF8I Module - Output Tags

Tag Name	Size	Definition	Valid Values
Ch[x].CalOutputHighRef	BOOL	Data value change that transitions the channel to produce the High Calibration Reference Point for the current *C.Ch[x].OutputRange* tag value.	• 0 = Do not Output Cal High Reference • 1 = Output Calibration High Reference Signal Do not set his tag and the CalOutputLowRef tag to 1 simultaneously.
Ch[x].CalLowRefPassed	BOOL	Data value change that indicates that the *O.Ch[x].Data* tag contains the recorded Low Reference value for the channel that is used by the module in Calibration.	• 0 = Not sending Recorded Cal Low Ref • 1 = Sending Recorded Cal Low Reference in Output Data for Calibration Verification
Ch[x].CalHighRefPassed	BOOL	Data value change that indicates that the *O.Ch[x].Data* tag contains the recorded High Reference value for the channel that is used by the module in Calibration.	• 0 = Not sending Cal High Reference • 1 = Sending recorded Calibration High Reference Signal in Output Data for Calibration Verification
Ch[x].CalFinishCalibration	BOOL	Data value change that triggers the channel to complete the Calibration procedure, applying the Valid Low and High References received. Channel exits the Calibration state if successful.	• 0 = Channel not triggered to complete the calibration procedure • 1 = Channel triggered to complete the calibration procedure
Ch[x].Data	REAL	Channel data in scaled Engineering Units.	Any positive or negative value. Determined by how you set the scaling parameters on the channel. For more information, see Scaling on page 37.

Notes:

Choose the Correct Power Supply

Power-sizing Chart

You can determine the power that modules contained in a ControlLogix chassis are consuming to maintain an adequate power supply.

An interactive spreadsheet is available that lets you enter a chassis configuration and automatically calculates the total power supply consumption. The total power supply consumption cannot exceed 75 W @ 60 °C (140 °F).

Refer to the configuration spreadsheet in Sizing the ControlLogix Power Supply, Knowledgebase Technical Note ID 22753.

The 5.1V DC and 24V DC currents are used together to calculate the maximum backplane power dissipation. The following table lists the current draw of each module.

Cat. No.	Current Draw at 5.1V DC	Current Draw at 24V DC
1756-IF8I	200 mA	• Voltage/Non-sourcing Current mode: 150 mA • Sourcing Current mode: 400 mA
1756-IRT8I	200 mA	150 mA
1756-OF8I	200 mA	• Voltage or Current mode with 250 Ω loads = 220 mA • Current mode with 500 Ω loads = 275 mA • Current mode with 750 Ω loads = 340 mA • Current mode with 1000 Ω loads = 385 mA

Use the following table to check power supply consumption.

Slot Number	Module Cat. No.	Current @ 5.1V DC (mA)		Power @ 5.1V DC (Watts)	Current @ 24V DC (mA)		Power @ 24 V DC (Watts)
0			x 5.1V =			x 24V =	
1			x 5.1V =			x 24V =	
2			x 5.1V =			x 24V =	
3			x 5.1V =			x 24V =	
4			x 5.1V =			x 24V =	
5			x 5.1V =			x 24V =	
6			x 5.1V =			x 24V =	
7			x 5.1V =			x 24V =	
8			x 5.1V =			x 24V =	
9			x 5.1V =			x 24V =	
10			x 5.1V =			x 24V =	
11			x 5.1V =			x 24V =	
12			x 5.1V =			x 24V =	
13			x 5.1V =			x 24V =	
14			x 5.1V =			x 24V =	
15			x 5.1V =			x 24V =	
16			x 5.1V =			x 24V =	
	TOTALS	mA		W	mA		W

Do not exceed the 5.1V DC current of 10 A for the 1756-Px72 power supply or 13 A for the 1756-Px75 power supply.

1492 Analog Interface Modules

As an alternative to buying RTBs and connecting the wires yourself, you can buy a wiring system that connects to I/O modules through pre-wired and pre-tested cables.

ATTENTION: The ControlLogix system has been agency certified using only the ControlLogix RTBs (catalog numbers 1756-TBCH, 1756-TBNH, 1756-TBSH and 1756-TBS6H). Any application that requires agency certification of the ControlLogix system using other wiring termination methods may require application specific approval by the certifying agency.

The following table lists the analog interface modules (AIFMs) available for use with the ControlLogix eight-channel isolated analog I/O modules.

IMPORTANT You can use the 6-channel AIFMs, for example, 1492-AIFM6S-3, listed with 8-channel isolated analog I/O modules.

We **recommend** that you use the 8-channel AIFMs, for example, 1492-AIFM8S-3, in your application whenever possible.

Module Cat. No.	Operating Mode	AIFM Cat. No. Fixed Terminal Block	AIFM Cat. No. RTB Socket Assembly	Pre-wired Cable Cat. No. where *x* = Cable Length
1756-IF8I	Current (Internal or External Source Loop Current)	1492-AIFM8S-3	1492-RAIFM8S-3	1492-ACABLExYA
	Current (External Loop Power only)	1492-AIFM8S-3	1492-RAIFM8S-3	1492-ACABLExYA
		1492-AIFM6S-3	1492-RAIFM6S-3	1492-ACABLExYA 1492-ACABLExYE
	Voltage	1492-AIFM8S-3	1492-RAIFM8S-3	1492-ACABLExYB
		1492-AIFM6S-3	1492-RAIFM6S-3	1492-ACABLExYB
1756-IRT8I	RTD	1492-AIFM8S-3	1492-RAIFM8S-3	1492-ACABLExYF
		1492-AIFM6S-3	1492-RAIFM6S-3	1492-ACABLExYF
	Thermocouple	1492-AIFM8TC-3	1492-RAIFM8TC-3	1492-ACABLExYC
		1492-AIFM6TC-3	1492-RAIFM6TC-3	1492-ACABLExYC
1756-OF8I	Current	1492-AIFM8S-3	1492-RAIFM8S-3	1492-ACABLExYA
		1492-AIFM6S-3	1492-RAIFM6S-3	1492-ACABLExYA
	Voltage	1492-AIFM8S-3	1492-RAIFM8S-3	1492-ACABLExYB
		1492-AIFM6S-3	1492-RAIFM6S-3	1492-ACABLExYB

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Rockwell Otomasyon Ticaret A.Ş., Kar Plaza İş Merkezi E Blok Kat:6 34752 İçerenköy, İstanbul, Tel: +90 (216) 5698400

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 1756-UM540A-EN-P - May 2014

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